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SPECIAL ANALYSIS OF WHEELED VEHICLES (WHEELS). PHASE II REPORT-ABRIDGED

Office of the Chief of Staff (Army)
Washington, D. C.

5 January 1973

AUGUST 1972

Special Analysis of Wheeled Vehicles

(WHEELS)

Phase II Report

ABRIDGED 5 JANUARY 1973

OFFICE, CHIEF OF STAFF, U.S. ARMY

OFFICE, CHIEF OF STAFF

U.S. ARMY

SPECIAL ANALYSIS OF WHEELED VEHICLES (WHEELS)

PHASE II REPORT

ABRIDGED

Contents have been edited to delete portions that are proprietary or classified. Other volumes of the Report, which are referenced herein, have security classifications of Confidential or higher. This Abridged Report is releasable to all parties.

5 January 1973

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF STAFF
WASHINGTON, D.C. 20310

DACS-ZC

15 SEP 1972

MEMORANDUM THRU: CHAIRMAN, WHEELS STEERING GROUP

FOR: CHIEF OF STAFF

SUBJECT: Phase II Report, Special Analysis of Wheeled Vehicles (WHEELS)

1. Forwarded herewith for approval is the Phase II Report of the Special Analysis of Wheeled Vehicles (WHEELS), established by Chief of Staff Memorandum 72-15-28, 10 February 1972.

2. The purpose of the WHEELS study is to conduct a comprehensive analysis of the Army's requirements for, management of, and utilization of wheeled vehicles and related equipment.

3. The Phase I report, approved on 2 May 1972, concentrated on those aspects of the wheeled vehicle fleet that serve as a basis for developing program or budget requirements. Phase I resulted in projections of tactical vehicle requirements which were approximately 25 percent below those contained in the FY 73 President's Budget (January 1972).

4. Phase II tasks are:

a. Definitize Phase I recommendations and develop expanded recommendations for consideration in the FY 74 Budget and FY 75-79 POM.

b. Complete all analyses (studies) and make firm recommendations that address themselves to achieving the overall assigned objectives of the WHEELS Study Group.

5. In Phase II, the quantitative requirements for wheeled vehicles were thoroughly examined and, in some cases challenged, resulting in significant reductions. The qualitative aspects of vehicle requirements

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SUBJECT: Phase II Report, Special Analysis of Wheeled Vehicles (WHEELS)

were also studied, and recommendations for relief from certain design criteria are made. Firm recommendations are developed for the expanded use of commercial vehicles within the tactical fleet, and in consideration of the changes envisioned by the study, the report contains a recommended FY 74 budget and follow-on program for tactical and commercial vehicles. All facets of management of the wheeled vehicle fleet have been examined, and recommendations are included for significant management improvement.

6. The Steering Group has provided continuous guidance in the conduct of the study. Extensive support and detailed comments on the Phase II report have been provided to the study by the Army Staff, USAMC, and USACDC. These comments have been incorporated where warranted, and the Steering Group has endorsed the Phase II recommendations as contained in the report.

Incl
as

for ROBERT J. BAER
Brigadier General, USA
Director, Wheels Study Group

21 SEP 1972

APPROVED - VCSA

GEORGE M. BAXTER
LTC, GS
Assistant Secretary of
the General Staff

IV

ABSTRACT

This study is a comprehensive analysis of the Army's need for, and the program management and utilization of, wheeled vehicles and related equipment. Reduction of vehicle numbers is addressed through critical analyses of TOE/TDA, identifying areas that generate vehicle requirements in excess of minimum essential needs. Reduction of qualitative requirements for vehicles is addressed through critical analyses of the threat situation, mobility requirements in different areas of combat theaters, and mobility capability comparisons of tactical and commercial vehicles with and without certain design features. Expansion of the use of commercial vehicles in lieu of military-design vehicles is addressed against a series of sensitive questions relating to mobility capability versus requirements, costs, mobilization, standardization, alternative logistic support concepts, warranties, and leasing. Sensitivity analyses, using the information generated from the quantitative, qualitative, and commercial vehicle analyses, provide the basis for study recommendations concerning the FY 74-78 Program, FY 74 Budget, and FY 75-79 Program. Management processes are analyzed under five areas: qualitative; quantitative; development, test, and evaluation; logistic support; and costs. The wheeled vehicle management structure analysis focuses on the degree of visibility required for decisionmaking. Information requirements generally are identified as a basis for modifying existing management information systems.

SPECIAL ANALYSIS OF WHEELED VEHICLES (WHEELS)

Members

WHEELS Steering Group

LTG William E. DePuy, Chairman	Assistant Vice Chief of Staff, U.S. Army
LTG Richard G. Stilwell (MG Donnelly P. Bolton)	Deputy Chief of Staff for Military Operations, HQ, DA
LTG Joseph M. Heiser, Jr.	Deputy Chief of Staff for Logistics, HQ, DA
LTG John M. Wright, Jr. (Mr. Eckhard Bennewitz)	Comptroller of the Army
LTG John Norton (MG Curtis W. Chapman, Jr.)	Commanding General, U.S. Army Combat Developments Command
LTG Robert R. Williams	Assistant Chief of Staff for Force Development, HQ, DA
LTG Woodrow W. Vaughan	Deputy Commanding General, U.S. Army Materiel Command
LTG William C. Gribble (MG George Sammet, Jr.)	Chief of Research and Development, HQ, DA
LTG HarrisW. Hollis (MG Morgan G. Roseborough) (MG Donald V. Rattan)	Chief, Office of Reserve Components, HQ, DA
Mr. Vincent P. Huggard	Deputy Assistant Secretary of the Army (Installations & Logistics)

WHEELS Study Group

BG John G. Waggener (Director, 10 Feb 72 - 14 May 72)	HQ, U.S. Army Materiel Command
BG Robert J. Baer (Director, 15 May 72 - present)	Office of the Chief of Research and Development, HQ, DA
Mr. Jack Hope (Consultant)	Executive Office of the President, Office of Science and Technology
Mr. Claron A. Robertson (Consultant)	
COL Kenneth R. Aboe	Office of the Deputy Chief of Staff for Logistics, HQ, DA

WHEELS Study Group (Continued)

COL Frank D. Conant, Jr.	Office of the Assistant Chief of Staff for Force Development, HQ, DA
COL Raymond L. Toole	HQ, 12th Spt Bde, Ft. Bragg, North Carolina
COL Horace W. Tousley	Office of the Assistant Vice Chief of Staff, U.S. Army
COL Elbert L. Butler, Jr.	HQ, U.S. Army Combat Developments Command
LTC George J. Mulcahy	Office of the Assistant Chief of Staff for Force Development, HQ, DA
LTC Daniel H. Pride	HQ, U.S. Army Combat Developments Command
LTC Wayne E. Spilker	Office of the Assistant Chief of Staff for Force Development, HQ, DA
LTC Irvin Darivoff	Office of the Assistant Secretary of the Army (Installations & Logistics)
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LTC Jerry D. Rackley	Office of the Deputy Chief of Staff for Logistics, HQ, DA
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MAJ Steven G. Beebe	U.S. Army Field Operating Cost Agency
MAJ Kent A. Modine	HQ, U.S. Army Materiel Command
MAJ Wayne D. Ploger	HQ, U.S. Army Materiel Command
MAJ William C. Brown	HQ, U.S. Army Materiel Command
Mr. William A. Freeborough	HQ, U.S. Army Tank-Automotive Command
Mr. Raymond W. McNeil	HQ, U.S. Army Test and Evaluation Command

WHEELS Study Group (Continued)

Mr. Abraham S. Pollack	Office of the Chief of Research and Development, HQ, DA
Mr. William E. Ransom	HQ, U.S. Army Tank-Automotive Command
Mr. Vernon E. Shomo	HQ, U.S. Army Materiel Command
Mr. William O. Sprang	Office of the Comptroller of the Army
Mr. Earl S. Brown	HQ, U.S. Army Combat Developments Command, Transportation Agency
Mr. Paul Cirri	U.S. Army Field Operating Cost Agency
Mr. LeRoy M. Danner	HQ, U.S. Army Materiel Command
Mr. Harold M. Donley	Office of the Deputy Chief of Staff for Logistics, HQ, DA

Administrative and Clerical

SFC James C. Ellis, Jr.	Walter Reed Army Medical Center
SSG Samuel H. Abatayo	HQ, USASA Support Gp, Ft. Meade, Maryland
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Mrs. Lorene Pacella	U.S. Army Computer Systems Command

Administrative and Clerical (Continued)

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Miss Virginia Carol Perdue	National Guard Bureau
Mrs. Eleanor Korbe	HQ, U.S. Army Materiel Command
Mrs. Alice Burke	HQ, U.S. Army Finance and Comptroller Information Systems Command

Part-Time Members

COL William E. Dasch	Office of the Deputy Chief of Staff for Personnel, HQ, DA
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LTC Edwin G. Moffatt	Office of the Deputy Chief of Staff for Personnel, HQ, DA
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MAJ Donald L. Whitlock	HQ, U.S. Army Combat Developments Command, Infantry Agency
MAJ Henry P. Brandt	HQ, U.S. Army Combat Developments Command, Field Artillery Agency
CPT William G. Byrne, Jr.	HQ, U.S. Army Transportation Center
1LT Albion Bergstrom	HQ, U.S. Army Combat Developments Command, Maintenance Agency
1LT Michael R. Hancock	HQ, U.S. Army Combat Developments Command, Maintenance Agency
Mr. Robert V. McKinley	HQ, U.S. Army Tank-Automotive Command
Mr. Allan T. Sylvester	HQ, U.S. Army Combat Developments Command
Miss Eileen T. Butler	HQ, U.S. Army Combat Developments Command, Communications-Electronics Agency

Part-Time Members (Continued)

Mr. Charles P. Charlet	HQ, U.S. Army Combat Developments Command, Armor Agency
Mr. Joseph A. Martaus	HQ, U.S. Army Combat Developments Command, Air Defense Artillery Agency
Mr. Julius B. Rosen	HQ, U.S. Army Combat Developments Command, Supply Agency
Mr. George W. Schreiner, Jr.	HQ, U.S. Army Combat Developments Command, Engineer Agency
Mr. Joseph S. Roj	HQ, U.S. Army Materiel Command

Mrs. Elizabeth A. Schensky (Technical Editor)
Mrs. Marilyn E. Redmond (Technical Editor)

TABLE OF CONTENTS

VOLUME I

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

AACOMS	Army Area Communications System
AAO	Authorized Acquisition Objective
ABF	availability balance file
ABT	all body type
ACSFOR	Assistant Chief of Staff for Force Development
ACSI	Assistant Chief of Staff for Intelligence
ADP	automatic data processing
AEF	American Expeditionary Forces
AFQT	Armed Forces Qualification Test
AIM	armored-infantry-mechanized
AMCR	Army Materiel Command Regulation
AMP	Army Materiel Plan
AMS	Army Management Structure
AMSAA	Army Materiel Systems Analysis Agency
AOA	American Ordnance Association
APE	advance production engineering
APG	Aberdeen Proving Ground
APOE	aerial port of embarkation
AR	Army regulation
ARNG	Army National Guard
ARVN	Army Republic of Vietnam
ASA	Army Security Agency
ASA (I&L)	Assistant Secretary of the Army (Installation & Logistics)
ASA (R&D)	Assistant Secretary of the Army (Research and Development)
ASL	Authorized Stockage List
ASP	Army Supply Program
ASPR	Armed Services Procurement Regulation
ATA	American Trucking Association
AVCSA	Assistant Vice Chief of Staff, Army
AVLB	armored vehicle launched bridge
BER	budget execution review
BOI	basis of issue
BOIP	Basis of Issue Plan(s)
C&C	command and control
C&T	contingency and training
CBOIP	Completed Basis of Issue Plan
CDB	computational data base

CDC	Combat Developments Command
CER	Cost Estimating Relations
CG	commanding general
ChiCom	Chinese Communist
CLG	civilian labor group
CO	carbon monoxide
COA	Comptroller of the Army
CONARC	United States Continental Army Command
CONDEC	Consolidated Diesel Electric Co.
CONUS	continental United States
COPARS	Contractor Operated Parts Stores
CORC	Chief, Office of Reserve Components
COSCOM	Corps Support Command
CRD	Chief of Research and Development
CSA	Chief of Staff, Army
CSM	Chief of Staff Memorandum
CS_3	Combat Service Support System
CTA	Common Table of Allowances
CTP	coordinated test program
CW	curb weight
DA	Department of the Army
DAAS	Defense Automatic Address System
DADAC	Department of the Army Distribution/ Allocation Committee
DAMPL	Department of the Army Master Priority List
DASSO	Department of the Army System Staff Officer
DAT	Director of Army Transportation
d. c.	direct current
DCSC	Defense Construction and Supply Center
DCSLOG	Deputy Chief of Staff for Logistics
DCSOPS	Deputy Chief of Staff for Military Operations
DCSPER	Deputy Chief of Staff for Personnel
DDPC	DCSLOG Data Processing Center
deg	degrees
DFE	division force equivalents
DIPEC	Defense Industrial Plant Equipment Center
DISCOM	division support command
DMIS	Director of Management Information Systems
DOD	Department of Defense
DODI	Department of Defense Instruction
DS	direct support
DSA	Defense Supply Agency
DSARC	Defense Systems Acquisition Review Council

DSS	direct supply support
DSU	direct support unit
DT	development test(s); development type
DTE	development, test, and evaluation
DUSA (OR)	Deputy Under Secretary of the Army (Operations Research)
DX	direct exchange
EDT	engineer design test
EMC	Equipment Maintenance Centers
EPA	Environmental Protection Agency
EPR	equipment performance report
ESP	engineering support to production
ET	engineering test
FAS	force accounting system
FASCOM	Field Army Support Command
FDC/CP	fire direction center/command post
FDP	funding delivery period
FET	Federal Excise Tax
FG	Fiscal Guidance
FOMCAT	Foreign Materiel Catalog
FPMR	Federal Property Management Regulation
FS	fuel service
FSCM	Federal Supply Code for Manufacturers
FSN	Federal stock number
FT	full tracked
ft-lb	foot-pound
FY	fiscal year
FYDP	Five Year Defense Program
GAO	General Accounting Office
GCW	gross combination weight
GFSR	General Functional Systems Requirement
GMC	General Motors Corporation
GS	general support
GSA	General Services Administration
GVW	gross vehicle weight
HAO	Hardware Action Officer
HC	hydrocarbons
HET	Heavy Equipment Transporter
HM	high mobility

hp	horsepower
HQ	headquarters
IAF	Item Application File
ICC	Inventory Control Center
ICTT	intensified confirmatory troop test
IFMIS	Integrated Facilities Management Information System
IHC	International Harvester Company
IIQ	initial issue quantity
ILO	in lieu of
ILS	integrated logistic support
IOC	initial operational capability
IPE	industrial plant equipment
IPR	in-process review
IPT	initial production test
ISSMIS	Integrated Support Service Management Information System
ITMIS	Integrated Transportation Management Information System
JFM	Joint Forces Memorandum
JTA	Joint Table of Allowances
LCO-P	Logistic Control Office—Pacific
LIN	line item number
LOC	line of communication (logistic routes)
LOI	letter of instruction
LOTS	logistics over-the-shore
LP-T	limited production—test
LP-U	limited production—urgent
MAB	mobile assault bridge
MAC	maintenance allocation chart
MACRIT	TOE Manpower Authorization Standards and Criteria
MAP	Military Assistance Program
MAPEX	Military Assistance Program Excess
MASF	Military Assistance Service Funded
MASSTER	Modern Army Selected Systems Test Evaluation and Review
MATCOM	Materiel Command
M-day	Mobilization Day

MFR	manufacturer
MI	military intelligence
MIDA	Major Item Data Agency
MIDP	Major Item Distribution Plan
MIL-STD	Military Standard
MILSTRIP	Military Standard Requisitioning and Issue Procedures
MILVAN	military-owned demountable container
MIMS	Major Item Management System
MIPR	Military Interdepartmental Purchase Requests
MIS	management information systems
MN	Materiel Need document
MN(A)	Materiel Need document (Abbreviated)
MOB CAT	Mobility Category
MOS	military occupational specialty
MOSC	military occupation specialty code
MPA	military personnel, Army
mph	miles per hour
MPN	manufacturer's part number
MPT	military potential test
MRRC	Materiel Requirements Review Committee
MSI	Maintenance Support Index
MS+	maintenance support positive
MSP	maintenance support plan
MSPG	Materiel Support Planning Guidance
MTDA	Modification Table of Distribution and Allowances
MTOE	Modification Table of Organization and Equipment
MYP	multiyear procurement
NCO	noncommissioned officer
NF	National Five
NFSN	non-Federal stock number
NICP	national inventory control point
NLT	not later than
NMIL	New Materiel Introductory Letter
NMP	national maintenance point
NORM	not operationally ready maintenance
NORS	not operationally ready supply
NO_x	oxides of nitrogen
OACSFOR	Office, Assistant Chief of Staff for Force Development

OAVCSA	Office, Assistant Vice Chief of Staff, Army
Obs	Obsolete
OCE	Office, Chief of Engineers
OCOA	Office, Comptroller of the Army
OCRD	Office, Chief of Research and Development
ODCSLOG	Office, Deputy Chief of Staff for Logistics
ODCSOPS	Office, Deputy Chief of Staff for Operations
ODCSPER	Office, Deputy Chief of Staff for Personnel
OMA	Operation and Maintenance, Army
ORF	Operational Readiness Float
ORSA	Operations Research/Systems Analysis
OSD	Office of the Secretary of Defense
OST	order shipping time
OT	operational test
OTE	operational test and evaluation
P&BG	program and budget guidance
P&P	procurement and production
PAT	production acceptance testing
PCS	permanent change of station
P-day	Production Day
PDM	Program Decision Memorandum
PEMA	Procurement of Equipment and Missiles, Army
PI	product improvement
PIP	Product Improvement Program
PL	pipeline
PLL	prescribed load list
PM	project manager
POE	port of embarkation
POL	petroleum, oils and lubricants
POM	Program Objective Memorandum
POMCUS	prepositioning of materiel configured to unit sets
PPG	personnel processing group; PEMA policy and guidance
PPT	preproduction test
PR	procurement request
psi	pounds per square inch
PTRF	peacetime rate factor
QA	quality assurance
QMR	qualitative materiel requirement

QQPRI	qualitative and quantitative personnel requirements information
RAC	Research Analysis Corporation
RAM-D	reliability, availability, maintainability, and durability
RCF	Repair Cycle Float
R&D	research and development
RD&E	research, development, and engineering
RDTE	research, development, test and evaluation
RECAT	Regulatory Effects on the Cost of Automotive Transportation
REVA	recommended vehicle adjustment
REVAL-WHEELS	Re-evaluation of the Army Tactical Vehicle Program
RF	radio frequency
RIBS	Restructured Infantry Battalion Systems
RMC	regular military compensation
RO	requisitioning objective
ROC	Required Operational Capability
ROKA	Republic of Korea Army
rpm	revolutions per minute
SACS	Structure and Compositon System
SAE	Society of Automotive Engineers
SAEB	Special Army Evaluation Board
SAILS	Standard Army Intermediate Level Supply Subsystem
SALS	Standard Army Logistics System
SAMBUD	Systems for Automation of Materiel Plan for Army Materiel/Budget
SAMPAM	System for Automation of Materiel Plans for Army Materiel
SAMS	Standard Army Maintenance System
SAR	Selected Acquisition Report
SASS	Standard Army Supply System
SATE	Study of Army Test and Evaluation
SB	Supply Bulletin
SDR	small development requirements
SEA	Southeast Asia
SEAVAN	commercial or Government-owned (or leased) shipping container
SI	spark ignition

SIMS	Secondary Items Management System
SPR	Systems Program Review
SRA	stock record account
SRC	standard requirement code
S&S	Supply and Service
SSE	System Status Evaluation
SSI	stock, storage, and issue
S&T	Supply and Transport
ST	service test
STANO	surveillance, target acquisition, and night observation
Std-A	Standard A
Std-B	Standard B
SYMWAR	System for Estimating Materiel Wartime Attrition and Replacement Requirements
TAADS	The Army Authorization Documents System
TAERS	The Army Equipment Records System
TAMMS	The Army Maintenance Management System
TASCOM	Theater Army Support Command
TB	technical bulletin
TC	type classification
TDA	Table(s) of Distribution and Allowances
TEL	transporter-erector-launcher
TM&DE	test, measuring and diagnostic equipment
TMP	transportation motor pool
TO	technical order
TODC	theater-oriented depot complex
TOE	Table(s) of Organization and Equipment
TOPS	test operations procedures
TT	troop test
TVRB	Tactical Vehicle Review Board
UIC	unit identification code
USACDC	United States Army Combat Developments Command
USACDCEC	United States Army Combat Developments Command Experimentation Command
USAEWES	United States Army Engineer Waterways Experiment Station
USAF	United States Air Force
USALDC	United States Army Logistics Data Center

USALDSRA	United States Army Logistics Doctrine, Systems and Readiness Agency
USAMC	United States Army Materiel Command
USAMICOM	United States Army Missile Command
USAMIDA	United States Army Major Item Data Agency
USAMSAA	United States Army Materiel System Analysis Agency
USAMSSA	United States Army Management Systems Support Agency
USAR	United States Army Reserve
USARAL	United States Army, Alaska
USAREUR	United States Army, Europe
USARHAW	United States Army, Hawaii
USARPAC	United States Army, Pacific
USARSO	United States Army Forces, Southern Command
USATACOM	United States Army Tank-Automotive Command
USATECOM	United States Army Test and Evaluation Command
USAWECOM	United States Army Weapons Command
USCONARC	United States Continental Army Command
USDT	United States Department of Transportation
U.S.S.R.	Union of Soviet Socialist Republics
VALID	Vehicle Average Life Information Developer
VCSA	Vice Chief of Staff, Army
WARF	wartime active replacement factor
WESCOD	Weapons System Cost Data Handbook
WHEELS	Special Analysis of Wheeled Vehicles
WIRF	wartime inactive rate factor
WWAP	worldwide asset position
XLWB	extra long wheel base
YPG	Yuma Proving Ground

CHAPTER I

OVERVIEW

1.0 GENERAL

(1) The need for an overall study of the Army's wheeled vehicle system can be brought sharply to focus by reference to a bibliography of studies concerning tactical vehicles. During the years 1966 through 1971, the Army conducted, or sponsored the conduct of, at least 16 major studies of tactical vehicles. In 1968, the Army was directed to do a study of tactical vehicles just 8 months after finishing a major study that had been directed by the same source and had taken almost 1 year to complete. Of the 16 studies, 10 were initiated or sponsored by a Department of the Army Staff element. Almost any conclusion could be drawn from this situation and probably would be only partially right or partially wrong.

(2) A further review of that bibliography would reveal some observations on which there can be little disagreement. A majority of the studies were generated as "fall-out" requirements of the pertinent programming and/or budget cycle, and often were targeted for completion before the next cycle—a period that could be less than 4 months. Others addressed rather limited aspects of the vehicle problem, such as pooling, allocation, serviceability, or cross-country requirements. Nearly all of the studies, whether by intention or not, demonstrated the desire for improvements in vehicle technology, data collection, utilization, resource efficiencies, mobility, and requirements determination. None of the studies, however, directly addresses the objective of improving overall management, yet collectively they all quite clearly reveal the profound complexities inherent in program management of the vehicle fleet.

(3) The Army vehicle fleet at present consists of approximately 600,000 trucks and trailers including several hundred makes and models in various shapes and sizes. The vehicles are used in almost every organization in the Army and perform thousands of different tasks. The fleet consumes almost 6 percent of the Army's budget in terms of acquisition and support. When viewed as a system, the fleet demonstrates such a degree of pervasiveness that one can understand the Army's continual search for improvements by way of almost end-to-end study efforts.

CHAPTER I

OVERVIEW

1.0 GENERAL

(1) The need for an overall study of the Army's wheeled vehicle system can be brought sharply to focus by reference to a bibliography of studies concerning tactical vehicles. During the years 1966 through 1971, the Army conducted, or sponsored the conduct of, at least 16 major studies of tactical vehicles. In 1968, the Army was directed to do a study of tactical vehicles just 8 months after finishing a major study that had been directed by the same source and had taken almost 1 year to complete. Of the 16 studies, 10 were initiated or sponsored by a Department of the Army Staff element. Almost any conclusion could be drawn from this situation and probably would be only partially right or partially wrong.

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(4) Two significant conclusions were drawn before yet another vehicle study was undertaken:

- The needed study should address all aspects of wheeled vehicles (i.e., the Army's requirements (quantitative and qualitative), utilization, and overall program management).

- The needed study required a long-term effort, but should still be responsive to the phasing of the program but budget cycles.

1.1 BACKGROUND

(1) In October 1971, the Assistant Secretary of the Army (Installations and Logistics) (ASA(I&L)) expressed to the Vice Chief of Staff, Army (VCSA), his interest in establishing a panel to undertake a general study of wheeled vehicles. The ASA(I&L) provided an outline of what the panel should investigate and report upon. The outline clearly touched on all aspects of the wheeled vehicle fleet, with emphasis on the need to achieve resource savings through quantitative and qualitative reductions as well as improved managerial concepts.

(2) The ASA(I&L) was advised that a panel would be formed to review the areas identified, isolate problems, make a complete review of existing data, and determine the parameters of any new study effort necessary. Chief of Staff Memorandum (CSM) 72-15-28, 10 February 1972, subject: "Special Analysis of Wheeled Vehicles (WHEELS)," established two ad hoc committees, a steering group and a study group, with the Assistant Vice Chief of Staff, Army (AVCSA), as the chairman of both groups and a general officer as director of the study group. Membership of the two groups is shown on page vii.

(3) The WHEELS Study Group was charged with conducting a comprehensive analysis of the Army's needs for, and program management and utilization of, wheeled vehicles and related equipment. The general objectives were to:

- Reduce quantitative and qualitative requirements to minimum essential levels

- Develop inputs for consideration in preparing the Fiscal Year (FY) 1974-78 Program Objective Memorandum (POM), the FY 74 Budget, and the FY 75-79 POM

- Consideration of the U.S. Army Combat Developments Command (USACDC) study, Tactical Vehicle Review Board (TVRB). This study, completed just prior to the convening of WHEELS, identified sizeable quantitative reductions in TOE.

- The changes in logistic factors used in calculating requirements over and above initial issue quantities (IIQs) (i.e., repair-cycle float, operational-readiness float, consumption, and others). These changes were the result of efforts by the Office of the Deputy Chief of Staff for Logistics (ODCSLOG), U.S. Army Materiel Command (USAMC), and the U.S. Army Tank-Automotive Command (USATACOM).

(2) Collectively, these actions resulted in projections of tactical vehicle requirements which were approximately 25 percent below those contained in the FY 73 President's Budget (January 1972). These projections provided the basis for the WHEELS Phase I recommendations concerning the FY 74-78 POM.

(3) During the Phase I period, additional efforts, not directly related to the development of recommendations for the FY 74-78 POM, were initiated. These were:

- Management. An analysis of the wheeled vehicle management processes and the organizational structure for administering those processes

- Development, Test, and Evaluation. An analysis of wheeled vehicle development, test, and evaluation policies, methods, and procedures

- Costs. A study to develop a mechanism that would ensure availability of valid acquisition, personnel, operating, and support costs for use in wheeled vehicle management

- Computer Applications. An analysis that identified and implemented computerized methodologies to support the WHEELS effort

- Commercial Vehicles. A study to determine expanded uses of commercial vehicles in lieu of military-design tactical vehicles

- Tactical Vehicles. A study of tactical vehicle policies, procedures, and requirements to determine and challenge those factors that generate qualitative (design) requirements in excess of minimum essential needs.

1.3 PHASE II ACTIONS

(1) During Phase II (1 April to 1 August 1972), the efforts undertaken in Phase I were continued with two additional requirements:

- Definitize Phase I recommendations and develop expanded recommendations for consideration in the FY 74 Budget and FY 75-79 POM

- Complete all analyses (studies) and make firm recommendations that address themselves to achieving the overall assigned objectives of the WHEELS Study Group.

(2) This document is the first of three volumes that report the results of the Phase II effort. In its three volumes, the report addresses six major areas, as follows:

- Minimum Essential Quantitative Requirements

- Minimum Essential Qualitative Requirements

- Commercial Vehicle Study

- Vehicle Selection Processes

- Fiscal Year 1974 Budget and Fiscal Years 1975-1979 Program Objective Memorandum

- Management.

(3) All of these study areas are addressed in summary, with recommendations, in subsequent chapters of Volume I. The first five are primarily "action" requirements in that their central thrust is to

develop recommendations that will permit an immediate reduction in wheeled vehicle resource requirements (i. e., reduced program and budget statements); details are presented in the individual annexes comprising Volume II. The last area, management, addresses processes, policies, procedures, and organizational structure, and thus is aimed at longer-range efficiencies; details are contained in Volume III.

(4) The six major study areas are briefly described below. The indicators following each title show the subsequent chapter and annex containing a greater level of detail.

1.3.1 Minimum Essential Quantitative Requirements (Chapter II and Annex B)

The objective of reducing the number of vehicles is addressed essentially through a series of critical analyses of various TOE/TDA. These analyses result in the identification of areas (e. g., messing, bulk fuel, wire-laying, mobility, ammunition basic loads, messenger service, ground surveillance, and others) generating vehicle requirements that appear to be in excess of minimum essential needs. These potential excesses were identified by quantity and cost, and through interactions between the WHEELS Study Group, WHEELS Steering Group, Department of the Army Staff, and USACDC, decisions were obtained and implementing actions ordered. Each area challenged is identified as a Recommended Vehicle Adjustment (REVA). Complete information concerning the first increment of REVA is contained in the Phase I Report. The second and third increments of REVA are examined in this report.

1.3.2 Minimum Essential Qualitative Requirements (Chapter III and Annex C)

The objective of reducing the qualitative aspects of vehicles is addressed by a process quite similar to that of the REVA. WHEELS requested USAMC and USACDC to identify qualitative requirement areas of significant importance within their respective responsibilities as the developer and user. These areas were then subjected to critical analysis in the light of the threat situation, mobility requirements in different areas of combat theaters, and mobility capabilities of tactical vehicles with and without certain design features. The areas selected for challenge, after considering the stated views of USAMC and USACDC, are identified in this report and recommended for approval to become part of the body of policies concerning vehicle requirements.

1.3.3 Commercial Vehicle Study (Chapter IV and Annex D)

The objective of expanding the use of commercial vehicles in lieu of military-design vehicles is addressed against a series of sensitive questions such as mobility capability requirements, costs, mobilization effects, multiplicity of makes and models (standardization), warranties, leasing, buy-back, testing, alternative logistic support concepts, and others. Roles, missions, and selected units in which commercial vehicles can be employed without adversely affecting combat capability or supportability are identified, and recommendations are made that will replace some military-design vehicles with commercial vehicles.

1.3.4 Vehicle Selection Processes (Chapter V and Annex E)

This part of the study consists of a series of sensitivity analyses (manual and computerized) using the information generated by the REVA actions, qualitative challenges, and the commercial vehicle study. Analyses were supported by the REVAL-WHEELS Model, as revised for the WHEELS Study effort. The revised model is referred to hereafter as the WHEELS Fleet Model. These analyses identified "fleet implications" (quantitative, qualitative, and cost) of several hypothetical fleet mixes that included standard tactical wheeled vehicles, tactical wheeled vehicles with design features eliminated (derated vehicles), and commercial vehicles. The objective was to determine the mixes that would create the least-cost/best-fleet condition while still giving due consideration to requirements, capabilities, and supportability. The results of these analyses provide the basis for WHEELS recommendations concerning the FY 74 Budget, FY 75-79 POM, and commercial vehicle selections, and also contribute to the study of management processes and organizational structures.

1.3.5 FY 74 Budget and FY 75-79 POM (Chapter VI and Annex F)

This section of the report contains a recommended budget and program for tactical and commercial vehicles that takes full consideration of reduced requirements, projected asset position, and age/distribution of the current inventory.

1.3.6 Management (Chapter VII and Volume III)

The objective of improving the management of the wheeled vehicle fleet has been addressed under three major areas.

- Management Processes
- Management Structures
- Management Information Systems.

1.3.6.1 Management Processes

The policy and procedural processes by which the fleet is managed are addressed under five areas.

- Determination of Qualitative Requirements
- Determination of Quantitative Requirements
- Development, Test, and Evaluation
- Logistic Support
- Costs.

1.3.6.2 Management Structures

The organizational structure for wheeled vehicle management within Headquarters, Department of the Army, and the recommended changes, designed primarily to increase "visibility" with respect to decisionmaking, are contained in this section. Analysis of the management "organization" below Headquarters, Department of the Army, is deferred to Phase III of WHEELS because of time constraints, scope of the requirement, and other ongoing Army-level studies.

1.3.6.3 Management Information Systems

Recognition of the need for a wheeled vehicle management information system (MIS) resulted from the immense difficulty experienced by members of WHEELS in obtaining basic data necessary to study management policies, procedures, processes, and decisions. Accordingly, this report identifies required information and recommends an MIS for the generation and processing of this information.

1.4 PHASE III ACTIONS

During Phase III, approximately six of the WHEELS personnel will be retained in a residual cell under the direction of the WHEELS Steering Group. Tasks during this phase are:

- Take necessary action through the staffing process to pursue to completion approved study recommendations not previously implemented
- Assist in the integration of the appropriate approved study recommendations into the FY 75-79 POM
- Bring to a conclusion those analyses initiated and not completed or terminated by the end of Phase II.

CHAPTER II

MINIMUM ESSENTIAL QUANTITATIVE REQUIREMENTS

2.0 GENERAL

The Phase II quantitative review continued the actions outlined in paragraph 1, Chapter II, Phase I Report (Annex A, Volume II—published separately) during the period 12 April through 31 July 1972. These actions involved critical review of selected Tables of Organization and Equipment (TOE) and Tables of Distribution and Allowances (TDA), and consideration of pertinent logistic factors to determine those requirements that generate demands for wheeled vehicles above minimum essential levels throughout the system. In addition, the following actions were completed:

- A comprehensive review and recomputation of the results of the U. S. Army Combat Developments Command (USACDC) Tactical Vehicle Review Board
- A detailed analysis and improvement of the data incorporated in the WHEELS Fleet Model
- Preparation of data to input approved Recommended Vehicle Adjustment (REVA) information into the computer model. These data were used for the vehicle selection processes (Chapter V of this volume, and Annex E).

2.1 RECOMMENDED VEHICLE ADJUSTMENTS

The review of TOE and TDA was completed in accordance with the procedures outlined in paragraph 2, Chapter II, of the Phase I Report. The review, accomplished in three increments, resulted in a total of 26 REVA, each proposing a downward adjustment in the basis for allocation of vehicles to specific Army task areas. The sections that follow provide a summary of the three increments of REVA, and Table II-1 provides a recapitulation of the effects of the recommended adjustments. A detailed discussion of REVA is presented in Annex B, Volume II.

TABLE II-1
RECAPITULATION OF RECOMMENDED VEHICLE ADJUST

REVA No.	Title	Tactical Vehicles Reduced	Commercial Vehicles Substituted	Net Vehicle Reduction		Trailer Reduction	
				IIQ	AAO	IIQ	AAO
1	Kitchen Trucks	1,362		1,362	1,520	0	0
2	Front Line Ambulances	1,190		1,190	1,380	0	0
3	Engineer Dump Trucks	4,991	2,618	2,373	3,074	691	746
4	Shop Vans	100		100	112	100	109
5	Chaplains' Jeeps	(68)[1]		(68)	(79)	(68)	(79)
6	Mobility	5,334		5,334	6,045	3,690	3,992
7	Basic Load-Arty	370		370	425	370	398
8	Redeye	1,640		1,640	1,958	447	510
9	POL Distribution	2,941		2,941	3,365	1,500	1,638
10	Messenger Vehicles	951	(1)[2]	951	1,091	450	486
11	Liaison Officers	913		913	1,064	911	985
12	Wire	2,944		2,944	3,247	371	388
13	Table Dist & Allow	7,000	5,000	2,000	2,959	0	0
14	Containers	Deferred					
15	Ground Surveillance	184		184	214	184	199
16	Staff Vehicles	2,056		2,056	2,366	270	292
17	Command & Control	1,000		1,000	1,163	658	710
18	Fire Trucks	475	475	0	0	N/A	N/A
19	Tow Vehicles	Disapp'd					
20	81-mm Mortars	Deferred					
21	Radio Platform Veh.	1,904	1,904	0	296	0	0
22	USAR Tng Divs	451	451	0	61	143	155
23	TC Line Haul	5,997	5,997	0	923	4,720[3]	375
24	Signal Construction	725	378	347	431	0	0
25	ASA/MI Units	815	401	414	518	479	513
26	S&T/S&S BN	Disapp'd					
	Total	43,275	17,224	26,051	32,133	10,196	11,417

[1] 68 1/4-ton trucks were deleted by TVRB; reinstated for affected TOE by REVA 16.

[2] One commercial panel truck, identified as a messenger vehicle, deleted.

[3] 16-ton trailers will be authorized on a 1:1 basis ILO the 12-ton trailers currently authorized.

2.1.1 First Increment

The WHEELS Steering Group approved six of seven proposed REVA for implementation prior to publication of the Phase I Report. A summary of the first increment actions is contained in paragraph 4, Chapter II, of the Phase I Report. The REVA contained in the first increment were:

- REVA 1 (Kitchen Trucks)
- REVA 2 (Front Line Ambulances)
- REVA 4 (Truck, Van, Shop 2 1/2-ton)
- REVA 5 (Chaplain Vehicles; see discussion of REVA 16)
- REVA 9 (Vehicular Bulk Fuel Handling Equipment)
- REVA 11 (Liaison Officers)
- REVA 12 (Wire Laying Vehicles).

2.1.2 Second Increment

Final Steering Group action was taken on the second increment of REVA on 7 June 1972. A summary of the second increment is contained in paragraph 5, Chapter II, of the Phase I Report. The actions by the Steering Group on the second increment are as follows.

2.1.2.1 REVA 3 (Dump Trucks)

This REVA proposed substitution of larger commercial vehicles for standard Army dump trucks. It was approved for implementation at the earliest practicable date. The final vehicle reductions are to be determined by a board chaired by a representative from the Office of the Assistant Chief of Staff for Force Development (OACSFOR), with participation from the Office of the Chief of Engineers (OCE) and USACDC. The results of the board's review are to be provided to Headquarters (HQ), Department of the Army (DA), by 2 October 1972.

2.1.2.2 REVA 6 (Ground Mobility)

This REVA involved reduction of the 100 percent mobility requirement for units that displace incrementally; it was approved for

implementation. USACDC has been directed to apply this REVA at the same time that it accomplishes TOE modifications specified by all other approved Category A REVA. The total of 5,365 vehicles identified for elimination is to be considered a goal by USACDC during the conduct of a doctrinal study supporting vehicle reductions. The final report of the study will be submitted by USACDC to HQ, DA, by 1 August 1973, with an interim report describing identified vehicle reductions to date due 29 December 1972.

2.1.2.3 REVA 7 (Basic Load, Conventional Munitions)

This REVA contended that reductions in vehicles assigned to haul basic loads of ammunition could be achieved. It was approved as modified by the Steering Group. The modifications were in accordance with the findings and recommendations of a special committee appointed under the supervision of OACSFOR to determine if a major revision of basic load policy was required. The committee's findings were presented to the Steering Group on 26 June 1972 and resulted in the decision to effect an approximate reduction of 10 percent in the Army's fleet of ammunition-carrying vehicles, both in field artillery and tank units. USACDC was tasked to determine specific reductions using anticipated expenditure rates in the various theaters as a guide, and to report actual reductions identified to OACSFOR on 31 August 1972.

2.1.2.4 REVA 8 (Redeye)

This REVA proposed pooling of vehicles at the Redeye section level rather than providing one vehicle for each team. It was approved for implementation in accordance with the following criteria:

- Maneuver battalions (less airmobile divisions) will be authorized two 1/4-ton vehicles with trailer per Redeye section.

- Field artillery battalions will be authorized one 1 1/4-ton vehicle with trailer per Redeye section.

This authorization will provide each maneuver battalion with a mobile section headquarters and two fully mobile Redeye teams. In field artillery units, only the section headquarters will have dedicated transport. Redeye teams not authorized vehicles will be required to use other available transportation. USACDC was directed to submit

a doctrinal study addressing revised vehicle authorizations to HQ, DA, by 1 August 1972.

2.1.2.5 REVA 10 (Messenger Vehicles)

This REVA was approved for implementation. All vehicles designated as motor messenger vehicles will be eliminated except in those TOE units that have the daily functional mission of supporting major headquarters with regular message center distribution. Additionally, USACDC was directed to examine the following units that were not considered by the Study Group for possible messenger vehicle reductions:

- Corps Signal Bn, TOE 11-15G
- Signal Army Area Bn, TOE 11-85H
- Army Command Signal Operations Bn, TOE 11-75H
- Army Command Signal Radio and Cable Bn, TOE 11-95G
- Signal Messenger Co, TOE 11-358G.

Reductions will be accomplished in all cases where the vehicle elimination will not seriously affect the unit's mission accomplishment.

2.1.2.6 REVA 13 (Tactical Wheeled Vehicles in TDA Units)

(1) This REVA was approved for implementation by HQ, DA, in consonance with The Army Authorization Documents System (TAADS). Generally, tactical wheeled vehicles will not be authorized in TDA units. However, exceptions may be made in cases where:

- A deployment mission precludes the use of commercial vehicles.
- Driver and mechanic training is to be part of the unit mission.
- Training in radio installation and operation is a unit mission requirement.

(2) The Steering Group approved an Assistant Chief of Staff for Force Development (ACSFOR) recommendation that tactical vehicles be provided in limited quantities for the training of radio mechanics and operators in circumstances where the use of commercial equipment is impractical. All exceptions require specific approval of HQ, DA. At this writing, OACSFOR already has eliminated 5,700 tactical wheeled vehicles under this REVA, replacing them with 3,600 commercial vehicles for a net savings of 2,100 wheeled vehicles.

2.1.2.7 REVA 14 (Containers)

This REVA proposed the development of a series of containers, as opposed to trucks, for use in housing such elements as fire direction centers and radio/radar stations. It was approved as a general guidance document that may require a research and development effort. The most immediate necessity in achieving the stated goals in the containerization field is the acceleration of the Army in-the-Field Container System Study being accomplished by USACDC and due for submission to HQ, DA, by 31 December 1972. Of particular importance is the early completion of that portion of the study that will allow for expeditious processing of an abbreviated Materiel Need Document (MN(A)) for the required flat-bed trailers. An estimated 15,000 trucks and 3,500 trailers can be saved by implementation of this REVA.

2.1.2.8 REVA 15 (Ground Surveillance)

This REVA was approved for implementation and will be accomplished by reorganizing the ground surveillance section of TOE 7-28 (Cbt Spt Co, Inf Bn), 17-19 (Cbt Spt Co, Sep Arm Bn), and 17-39 (Cbt Spt Co, Tk Bn). This reorganization deletes the section headquarters, resulting in the elimination of one 1/4-ton truck and trailer and two enlisted men from the section.

2.1.2.9 REVA 16 (Staff Transport Vehicles)

This REVA was approved for implementation as modified by Steering Group decision. The following criteria will be applied to effect vehicle reductions:

- Staff vehicle authorizations in headquarters of brigades, groups, and similar units will be on the basis of one vehicle per two staff sections, plus one for each authorized chaplain.

- Authorization for staff vehicles in the armored-infantry-mechanized (AIM) division headquarters will be as follows:
  - Headquarters and Headquarters Company, Infantry Division—13
  - Headquarters and Headquarters Company, Armored Division—14
  - Headquarters and Headquarters Company, Mechanized Division—14
- No organic staff transportation will be authorized in the Headquarters and Headquarters Company, Army.
- There will be no change to current authorizations for battalion, corps, Field Army Support Command (FASCOM), and Theater Army Support Command (TASCOM) Headquarters.

2.1.2.10 REVA 19 (TOW Antitank Vehicles)

This REVA proposed the substitution of a single GAMA GOAT for the two vehicles currently authorized in each TOW section. Although it was not approved, USACDC was directed to accomplish a study on related doctrinal matters. A final decision on this REVA will be made after review of the USACDC study, due at HQ, DA, by 1 August 1972.

2.1.2.11 REVA 20 (81-mm Mortar Vehicles)

This REVA proposed the elimination of 81-mm mortar platoons and, to supplant this loss, the provision of fire support by higher level units. The final decision on this REVA was deferred pending HQ, DA, review of a required study. Study requirements are to be met by completion of two current USACDC studies: Restructured Infantry Battalion Systems (RIBS) and Review of Mortar Requirements. These are scheduled for submission to HQ, DA, in the August 1972 time frame. Vehicle adjustments will be determined on the basis of final DA action taken on the findings and recommendations of the two studies.

2.1.3 Third Increment

The third and final increment of REVA were presented to the Steering Group for initial consideration on 26 May 1972, and for final decision on 5 July 1972. Summaries of these REVA and actions directed are presented in subsequent paragraphs.

2.1.3.1 REVA 17 (Command and Control Vehicles)

This REVA was approved on a substantially reduced basis. It challenges that requirement for transport used by commanders, deputy commanders, executive officers, platoon leaders, section chiefs, or other supervisory personnel in cases where it appears that the vehicle is more of a convenience than a requirement, and where mission accomplishment could be achieved using pooling methods. In its decision, the Steering Group directed USACDC to apply this REVA in combination with the Mobility REVA, and set 1,000 as the goal for total command and control vehicle reductions. Further, USACDC was directed to identify the specific vehicle reductions accomplished in conjunction with submission of the Mobility REVA interim and final reports due on 29 December 1972 and 1 August 1973, respectively.

2.1.3.2 REVA 18 (Fire Trucks)

This REVA was approved for implementation. It recommends that the tactical vehicle-mounted fire-fighting equipment currently authorized in TOE/TDA be replaced by an equivalent commercial model. Additionally, the decision on this REVA is noted as constituting DA waiver of the portion of SB 700-20 that limits authorization of any commercial vehicles to TDA units only.

2.1.3.3 REVA 21 (Tactical Vehicles Used as Radio Power Platforms)

This REVA was approved for implementation and will result in the elimination of tactical vehicles in TOE/TDA units that serve solely as a power source to operate radio equipment. It will also serve to replace the tactical vehicles and radios with commercial equipment in all cases where the unit mission and operational requirements will permit. USACDC, in conjunction with OACSFOR and U.S. Army Materiel Command (USAMC), was tasked to develop the requirement for an off-the-shelf type FM radio, suitable for mounting in a Scout/Bronco-type vehicle for use in nondeployable TOE units.

2.1.3.4 REVA 22 (USAR Training Divisions)

This REVA was approved for implementation. USACDC was directed to accomplish the specific substitution of selected commercial vehicles for tactical versions in U.S. Army Reserve training divisions. In making the substitutions, USACDC will preserve the current load-carrying capability of the affected units.

2.1.3.5 REVA 23 (Transportation Line-Haul Units)

This REVA was approved for implementation and will result in a 1-for-1 substitution of a commercial 8-ton tractor for the presently authorized 5-ton military tractor in all Transportation Corps line-haul units (TOE 55-18 and 55-67). USACDC was tasked to determine the specific number of substitutions and enumerate these in the required doctrinal study to be submitted to HQ, DA, on 15 October 1972. Additionally, USACDC will initiate action to adopt a compatible semi-trailer to take advantage of the increased load-pulling capacity of the 8-ton tractor.

2.1.3.6 REVA 24 (Communication Construction Equipment)

This REVA was approved for implementation. A single, improved telephone-construction maintenance truck will be developed and substituted for the two vehicle types currently in use—the V-17A and V-18. The former provides a platform used in hanging wire and for testing and maintenance on completed lines. The V-18 provides the equipment to bore the holes in which telephone poles are set. The proposed vehicle will incorporate all of these functions. The decision on the REVA specifies that the determination be made during the Basis of Issue Plans (BOIP) development of whether additional vehicle savings can be realized as a result of the apparent increased efficiency of the proposed vehicle. Also, USACDC was directed to reexamine the possibility of using available commercial equipment in lieu of developing the proposed vehicle. All of these tasks will be accomplished during the development of the Materiel Need (MN) documents for the proposed telephone construction maintenance truck.

2.1.3.7 REVA 25 (Army Security Agency/Military Intelligence Units)

This REVA was approved for implementation and will result in substantial vehicle savings in Army Security Agency/Military Intelligence (ASA/MI) units through vehicle pooling, in some cases, and the

substitution of commercial vehicles for tactical versions in instances where the use of such a vehicle will not degrade the unit's capability. All ASA/MI TOE are considered under this REVA, which essentially incorporated all other pertinent REVA in a single application.

2.1.3.8 REVA 26 (Substitution in S&T and S&S Battalions)

This REVA was disapproved by the Steering Group. It proposed that, in the Supply and Transport (S&T) and the Supply and Service (S&S) Battalions, the 2 1/2-ton cargo trucks and trailers be replaced by a 5-ton cargo truck on a 2-for-3 basis and, in those elements of these battalions which currently are 5-ton equipped, the 5-ton tractors and their companion M127 trailers be replaced by yet-to-be-selected 8-ton commercial truck tractors and 16-ton trailers, respectively.

2.1.3.9 REVA 27 (Trailers)

This REVA provides a convenience summary of all REVA actions affecting tactical trailers.

2.1.4 Projected Resource Savings From REVA

As shown in Table II-1, the projected resource savings that result from the implementation of all REVA are listed in this section.

- Tactical Vehicles Reduced: 43,275
- Commercial Vehicles Substituted: 17,224
- Net Vehicle Reduction (IIQ): 26,051
  (AAO): 32,133
- Trailer Reduction (IIQ): 10,196
  (AAO): 11,417

2.1.5 Recommendation

Publish a change to AR 310-34 "Equipment Authorization Policies and Criteria, and Common Tables of Allowances" initiated by ACSFOR which will incorporate the rules established by the approved REVA into Section III (Motor Vehicles), Chapter 4, of the AR. The change will implement the approved REVA and provide definitive guidance to the TOE/TDA proponent concerning authorizations for wheeled vehicles in TOE/TDA units. (The complete change is contained in Annex B, Volume II.)

2.2 LOGISTIC FACTORS

(1) Acting on staff guidance provided by the DA Deputy Chief of Staff for Logistics (DCSLOG), USAMC and the U.S. Army Tank-Automotive Command (USATACOM) made significant changes in the logistic factors used for gross requirement computations for wheeled vehicles during the conduct of this study. These changes were caused by the implementation of the System for Estimating Materiel Wartime Attrition and Replacement Requirements (SYMWAR), the revision of deployment schedules, the revision of requirements for Allied Forces, and the effectiveness of the Logistics Offensive Program.

(9) The major changes to the gross requirements computation were wrought by the application of SYMWAR and the computation of new maintenance float factors. SYMWAR was coordinated within the Army Staff with OACSFOR and Office, Deputy Chief of Staff for Operations (ODCSOPS). It is now accepted as a programming and planning tool within ODCSLOG. The maintenance float factors were computed using historical data and the methodology of AR 750-15.

2.3 TACTICAL VEHICLE REVIEW BOARD

The USACDC Tactical Vehicle Review Board (TVRB) prepared a detailed analysis of tactical vehicle requirements in TOE units. This study was presented to HQ, DA, and the findings were approved in March 1972. The TVRB findings were applied to the WHEELS Fleet Model and resulted in a requirements reduction of 17,213 tactical wheeled vehicles in TOE units. All recommended or alternative fleet mixes reflect the TVRB findings as applied to the WHEELS Fleet Model and are included in Initial Issue Quantity/Authorized Acquisition Objective (IIQ/AAO) computations.

2.4 OTHER FACTORS CONTRIBUTING TO QUANTITATIVE REDUCTIONS

(1) Changes in force structure provided for a reduction in tactical vehicle requirements as units were eliminated to meet reduced end-strengths.

(2) The Equipment Survey Teams under the staff supervision of ACSFOR should make significant future contributions to the vehicle reduction program. Equipment surveys of two CONUS installations were monitored by members of the WHEELS Study Group and were found to be well organized, efficiently operated, and dedicated to a conscientious effort to reduce equipment authorizations to the minimum essentials required for mission accomplishment. The rules and guidelines developed by the WHEELS Study Group will materially aid the Survey Teams in their efforts toward vehicle reductions.

(3) The WHEELS Fleet Model materially aided in refining the REVA effects on the Army as a whole. By providing input data based on REVA recommendations and comparing these to a selected force structure, the actual results of REVA reductions have been computed. This capability greatly aided AAO computations and demonstrated its usefulness as a management tool. This model is discussed more fully in subsequent chapters.

CHAPTER III

MINIMUM ESSENTIAL QUALITATIVE REQUIREMENTS

3.0 GENERAL

(1) Criticisms directly related to the size of the Army's wheeled vehicle fleet have influenced the Study Group to develop recommendations that already have caused or will result in significant reductions in this fleet. However, other criticisms relating to qualitative features of vehicles have similarly guided the Study Group to an investigation and evaluation of the Army's qualitative requirements. One such recurring criticism is that military vehicles contain "gold-plating" in characteristics that are infrequently used, more expensive than they need be, and more expensive than their commercial counterparts performing similar tasks in industry. Another commonly expressed criticism relates to the belief that commercial vehicles operating in selected industries possess adequate cross-country and rough-terrain mobility to fulfill Army needs, and do not require the added expense associated with the departure from standard production practices to accomplish redesign to meet military specifications. This same point has been raised within the Army, although no means other than subjective reasoning has existed to compare and evaluate the mobility capabilities of vehicles, or to select a vehicle that possesses only the minimum essential characteristics and is capable of accomplishing its required tasks.

(2) Proper investigation of these broad qualitative criticisms first required the review of the overall threat environment that Army tactical vehicles would be subjected to over the next few years. A part of this investigation involved consideration of the capabilities of the vehicle fleets of potential enemies (i.e., the enemy mirror threat) as well as those of probable allies. Another area of investigation was the actual mobility requirements of the tactical wheeled vehicle fleet, with special attention given to current capabilities and the possibility of restructuring the fleet to provide minimum essential mobility capability by removing unnecessary features wherever possible. Finally, the results of these efforts were compiled and applied to the wheeled vehicle fleet remaining after the quantitative reductions to determine the quantity/quality relationships required for vehicles of various

configurations and mobility capabilities. Each of these areas is summarized in subsequent paragraphs of this chapter. A detailed discussion is contained in Annex C, Volume II.

3.1 THREAT ANALYSIS

The analysis of the worldwide threat is classified above the overall classification of this volume. A detailed discussion is contained in Appendix 1, Annex C.

3.2 MOBILITY REQUIREMENTS

(1) Worldwide applications dictate that wheeled vehicle design must provide capabilities for overcoming obstacles ranging from deserts to swamps and from rivers to blown-down trees in both hot and cold climate operations. "High-mobility" and "conventional-mobility" concepts have evolved which provide for division of tactical wheeled vehicle fleets into two functional categories: one possessing extensive cross-country capabilities to meet requirements for use in the ground-gaining environment, and the other having reduced mobility capabilities because of the envisioned limited use of the vehicles in off-road operations. The primary characteristics differentiating these two general design groups are listed on the following page.

- The ability to swim
- The ability to operate effectively in rugged terrain and soft soils
- The ability to be air-dropped or air-delivered in the early stages of airborne operations.

The difficulty in attaining a good swimming capability in tactical wheeled vehicles and the increased availability and improved capability of air transport and tactical bridging (e. g., armored vehicle launched bridge (AVLB), mobile assault bridge (MAB), and Ribbon) have minimized the need for this characteristic. However, taking advantage of the improvements in truck technology, efforts should continue to refine designs of tactical wheeled vehicles to improve their cross-country capabilities.

(2) Recognition of a third mobility grouping is necessary to accommodate those units having mission tasks that do not involve cross-country movements and permit the use of vehicles possessing lower off-road capabilities. Such a grouping (i. e., "low-mobility"), pertaining to vehicles used primarily in operations over prepared road surfaces, will provide for redesigned standard vehicles that have higher mobility related components removed, but still possess the capabilities required to meet mission tasks at significantly reduced costs.

3. 2. 1 Mobility Analysis

(1) Previous assessments of the mobility capabilities of various tactical vehicles have proved to be inadequate and inconclusive. These results were primarily due to the fact that, even though a large number of factors influencing mobility could be individually and mathematically calculated, they could be applied collectively only on a subjective basis.

(2) The AMC-71 Ground Mobility Model, currently under development as a research effort, was selected as a means to systematically quantify relative vehicular mobility. The output of the model is depicted in terms of speed-made-good over selected terrain. The model is summarized in Chapter V of this volume, with a detailed description presented in Annex C, Volume II.

(3) Performance and design characteristics were examined for 48 vehicles and vehicle/trailer combinations, with the resulting data applied to the computer model. Terrain descriptions from specific areal traces in West Germany, Thailand, and Arizona, which included conditions varying from hard-surfaced highways to rugged cross-country features, also were included. The AMC-71 Ground Mobility Model provided detailed explanations of the relationship between those obstacles inhibiting movement and the design characteristics that are the basis for limiting speed over such obstacles. This information, which provides invaluable assistance in predicting the ability of proposed vehicular designs to operate over specific sets of terrain features, was used to compare and assess the capabilities of the existing tactical wheeled vehicle fleet in various configurations. (See Table III-1.)

3.2.2 Current Tactical Vehicle Fleet Configuration

The design goals for tactical wheeled vehicles have tended to cause production of trucks oriented toward the most demanding task (i.e., extensive cross-country use). This is most evident when looking at common characteristics applicable to all of these vehicles, such as all-wheel drive and deep-water fording or swimming. Peripheral characteristics considered necessary for cross-country movement under varying conditions also are common and include features such as blackout lights, favorable power-to-weight ratio, increased overall gear reduction, and provisions for negotiating increased angles of approach and departure. A review of the significant design characteristics of the current tactical wheeled vehicle fleet reveals the similarity of these features within the various vehicle body types, and also indicates the occurrence of inconsistencies in design that tend to cloud the issue of overall mobility capability. (See Table III-2.) An example of the areas where confusion in design has been created can be seen by examining the maximum road speeds for all cargo vehicles. These are fairly consistent except for the 8-ton GOER, which is classified as a very-high-mobility truck. Operating at a maximum of 30 mph on highways, this truck represents an impediment to mobility in terms of speed-made-good, which is a primary component of any mobility calculation.

3.2.3 Restructured Fleet Configuration

(1) A major purpose of the WHEELS Study effort was to produce firm recommendations for the reduction of the quantity and quality of the wheeled vehicle fleet to the minimum essential levels.

TABLE III-1
VEHICLE MOBILITY CAPABILITIES: 5- AND 8-TON TRUCKS/TRACTORS

Line No.	Type of Vehicle	West Germany				Thailand				Arizona			
		1	2	3	4	1	2	3	4	1	2	3	4
1	M813 (6 x 6 5-ton Truck)	5.2	99.2	21.0	35.9	1.9	83.9	17.5	48.7	2.9	99.7	17.2	42.5
2	M656 (8 x 8 5-ton Truck with High Mobility)	11.9	99.4	26.0	35.9	3.4	97.0	25.3	48.7	5.4	99.7	24.3	42.5
3	Commercial (6 x 4 5-ton Truck)	3.1	96.3	27.6	34.3	0.1	21.5	23.0	45.0	3.3	96.3	23.0	39.8
4	M813 (6 x 4 5-ton Truck)	0.5	72.0	21.0	35.9	0.1	20.0	17.5	48.7	2.8	93.7	17.2	42.5
5	M520 (4 x 4 8-ton Truck)	6.0	99.3	20.3	26.2	0.5	84.0	23.8	29.7	3.9	99.7	23.1	27.8
6	M818 + M127A1C (6 x 6 5-ton Tractor with 12-ton Semitrailer)	0.2	55.4	20.5	35.9	0.1	12.7	16.9	48.7	2.4	92.0	16.7	42.5
7	Commercial + M127A1C (6 x 4 5-ton Tractor with 12-ton Semitrailer)	0.1	25.9	20.5	35.9	0.1	8.5	16.9	48.7	2.1	92.0	16.7	42.5
8	Commercial (More Power) + M127A1C (6 x 4 5-ton Tractor w/12-ton Semi-trailer)	0.5	72.8	26.6	35.9	0.1	19.0	23.0	48.7	2.6	92.0	23.0	42.5
9	M818 + M127A1C (6 x 4 5-ton Tractor w/12-ton Semitrailer)	0.2	43.8	20.5	35.9	0.1	12.2	16.9	48.7	2.4	92.0	16.7	42.5

Explanation of numbered column headings:

1 — Speed-made-good in miles per hour over 90 percent of the best terrain in a 4 x 50 km trace.
2 — Percent of terrain obstacles negotiable within the terrain trace.
3 — Speed-made-good in miles per hour on secondary roads within the terrain trace.
4 — Speed-made-good in miles per hour on primary roads within the terrain trace.

TABLE III-2
SUMMARY OF SELECTED VEHICLES AND CHARACTERISTICS

Vehicle Characteristics	1/4-ton 4 x 4 M151A2	1/4-ton 4 x 4 Commercial	3/4-ton 4 x 4 M37B1	1 1/4-ton 4 x 4 M715E1	1 1/4-ton 4 x 4 M705	1 1/4-ton 6 x 6 M561	1 1/4-ton 4 x 4 Commercial	2 1/2-ton 6 x 6 M35A2	2 1/2-ton 4 x 2 Commercial	5-ton 6 x 6 M813	5-ton 8 x 8 M656	5-ton 6 x 4 Commercial	8-ton 4 x 4 M520E1	5-ton 6 x 6 M818 w/Tlr M127A1C	5-ton 6 x 4 Com. w/Tlr M127A1C	10-ton 6 x 6 M123A1C w/Tlr M172A1	22 1/2-ton 8 x 8 XM746 w/Tlr M747	22 1/2-ton 8 x 4 Com. w/Tlr M747
Gross Vehicle Weight (kips)[1]	3.2	4	7.6	8.4	8.8	9	7	18.8	14.5	31.8	25.2	17.6	43.2	58.9	51.8	96.6	179	156
Gross Rated Horsepower (bhp)	71	111	75	116	160	103	140	140	131	250	210	225	213	250	335	300	600	555
Vehicle Rated Horsepower per Ton	44	55	20	28	36	23	40	15	18	16	17	26	10	9	8	6	7	6
Road Speed (mph)	60	60	55	50	60	55	50	50	60	52	50	60	30	50	50	30	36	36
Number of Axles	2	2	2	2	2	3	2	3	2	3	4	3	2	5	5	5	8	8
Vehicle Width (in.)	64	70	73	85	83	84	79	96	90	97	96	95	108	97	97	115	120	120
Vehicle Length (in.)	133	165	185	210	199	227	210	264	234	301	276	244	375	538	489	624	732	741
Vehicle Swimming Speed (mph)	0	0	0	0	0	2.5	0	0	0	0	2.5	0	3	0	0	0	0	0
Fording Depth or Draft Height (in.)	60	13	79	60	60	37	15	72	17	78	69	22	63	55	24	30	48	25
Number of Tires	4	4	4	4	4	6	4	10	6	10	8	10	4	18	18	18	24	24
Transmission Gears	4	6	8	8	8	8	6	10	8	5	5	5	6	5	10	10	5	10
Vehicle Departure Angle (deg)	37	26	32	25	45	45	13	40	25	32	64	42	37	70	75	75	82	68
Vehicle Approach Angle (deg)	66	43	44	45	61	62	28	48	36	46	55	56	35	45	46	52	30	26
Minimum Ground Clearance (in.)	9	9	11	10	12	15	8	11	10	11	12	10	24	12	11	16	11	11
Ground Pressure, (Hi-Way) (psi)	26.4	36.9	40.3	34.2	46.1	20.2	47	53.1	60.7	64.2	36.9	56.4	19	64.5	61.8	50.5	60.7	58.7

[1] 1 kip = 1,000 pounds.

Quantitative reductions were dealt with in Chapter II. From the quality viewpoint, design goals for a modified fleet should provide for more selectivity among vehicle types to adequately, but not excessively, fill the requirements for vehicles in units operating out of the ground-gaining environment, where more choice in route and time-to-move exists. Vehicles operating to the rear of the division should be available without many of the expensive mobility aids provided to combat and combat support units operating in forward areas. The minimum basic form of a restructured fleet should recognize requirements for three distinct mobility classes—high, conventional, and low. Standard tactical wheeled vehicles and derated versions should be available for these missions and supported in the existing logistic support system.

(2) Significant increases in the total miles of hard-surfaced roads available in those critical areas of the world of prime interest to the Army must be considered in looking at new vehicle requirements. From 1948 to 1971, the miles of surfaced roads have increased in Europe and Asia by 88.9 and 197.7 percent, respectively. (See Table III-3.)

TABLE III-3
COMPARATIVE WORLDWIDE HARD-SURFACE ROAD MILEAGES[1]
(Mileages in Thousands)

Location	1948[2]	1971	Percent Increase
Europe	671.7	1,269.5	88.9
Asia	141.10	420.1	197.7
Africa	87.10	291.50	234.6
The Americas (Except USA)	225.0	635.1	272.2
USA	1,503.8	2,946.4	95.9

[1]All mileage figures are provided by International Road Federation.

[2]1948 mileage figures are for hard-surfaced roads. Hard-surfaced roads are defined as those which have been graded and drained, and then surfaced with either stabilized soil, gravel, stone, cement, concrete, stone block, brick, or low- or high-type bituminous construction.

(3) Other considerations for restructuring the fleet, however, remain to be evaluated during Phase III of WHEELS. For example, through the combined efforts of various organizations in the Army, several methodologies now are available which can better define the various tasks that vehicles must perform in different portions of the combat area. These same methodologies permit a more precise correlation of these requirements with real or conceptual vehicle capabilities. These future evaluations should include consideration of vehicles that respond to the high-mobility requirements in the brigade areas, as well as seeking more efficiencies through the evaluation of lower capability vehicles for use in rear areas. Specifically, the current Army inventory does not have vehicles in the 1/4-, 2 1/2-, and 5-ton payload categories that will meet, qualitatively in some cases and quantitatively in others, the high-mobility requirements of forward area units. Whereas the high cost of obtaining these capabilities has precluded such efforts in the past, WHEELS believes that, concurrent with overall quantitative and qualitative reductions for selected vehicles, sufficient economics have been effected to permit the Army to seek true mobility capabilities for all areas.

3.3 QUALITATIVE CHALLENGES

(1) During Phases I and II of the study, the qualitative characteristics of the tactical wheeled vehicle fleet were analyzed to determine how and why the fleet was structured as it is, and if any changes could be made that would reduce some of the expensive qualities of vehicles. Representatives of the U.S. Army Materiel Command (USAMC) and the U.S. Army Combat Developments Command (USACDC) participated in this effort. All characteristics of the fleet were detailed and compared to determine if expensive add-ons or features were being procured which had little or no application when the vehicle was employed by units in the field. This comparison required the definition of where the unit would be located in the Army in-the-field and, further, what each vehicle in each unit would have as its task and what that task would entail in terms of mobility requirements. A simple definition of mobility requirements was prepared to provide for categorization of vehicle missions according to requirements for a high, moderate, or low degree of obstacle-crossing capability.

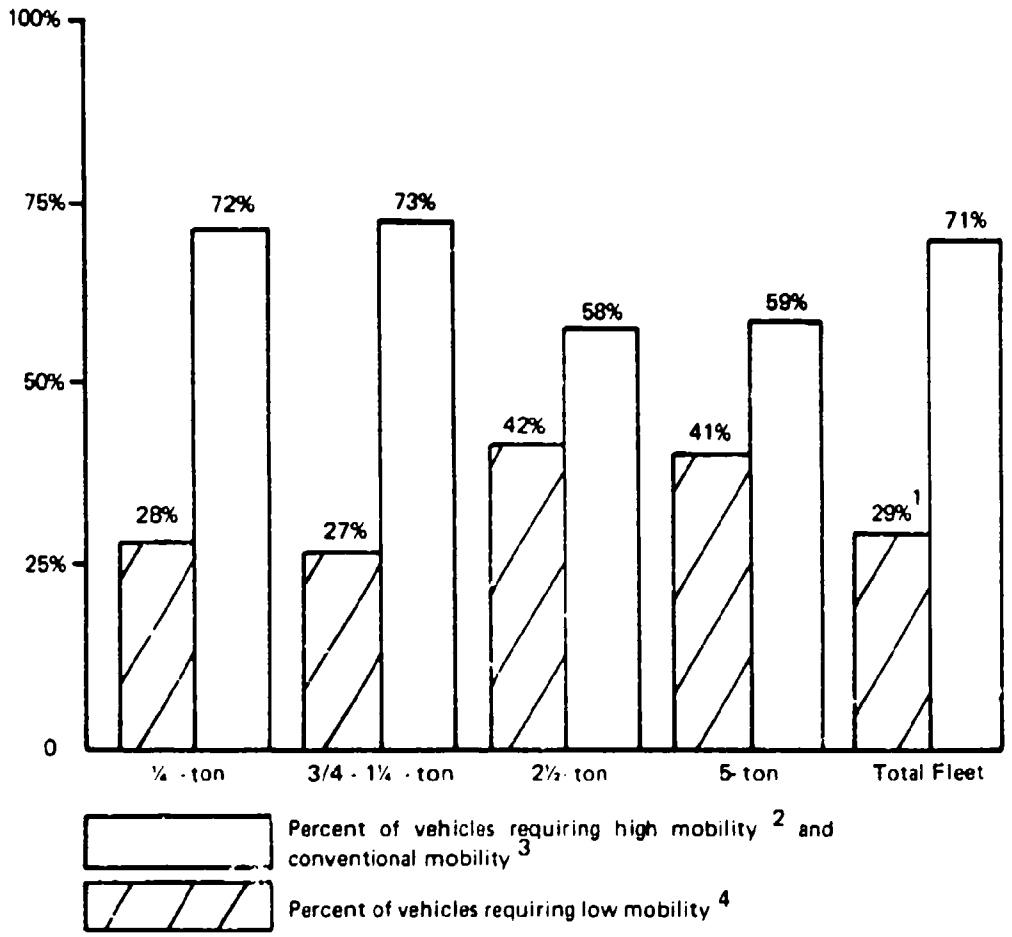
(2) After completing the detailed investigation of each unit, vehicle, and task, the remaining area of consideration concerned fleetwide quantities and qualities, and required an analysis of vehicle requirements in all units as they currently exist and are programmed

to exist in the Army's force structure. All of the previous studies examined indicated a need for improved cross-country capabilities in units with ground-gaining and close support missions, but recognized a decreasing requirement for such obstacle-crossing capability as the unit operates farther to the rear in the combat environment. The findings shown in Figure III-1 indicate that, for over 29 percent of the fleet, a low degree of cross-country mobility will suffice and the use of vehicles possessing minimal mobility chracteristics is permissible. Substitution of such vehicles offers acquisition, operating, and maintenance cost savings.

3.3.1 Design Features Common to the Tactical Wheeled Vehicle Fleet

(1) Table III-2 shows selected characteristics of vehicles currently in or scheduled into the tactical vehicle fleet. Comparison of these characteristics of the various vehicle weight groups indicates that the general design goals are similar except for the most stringent obstacle-crossing capability (i.e., swimming). Based on these characteristics and within the associated payload categories, the graphic portrayal of the fleet applied to a theater of operations shown in Figure III-2 was developed. As can be seen, a clear definition of fleet design and application indicates that the high-mobility (i.e., swimmer and very-rough terrain) vehicles are generally oriented to the forward ground-gaining role (except the 5-ton M656 which, due to limited numbers produced, is presently employed in PERSHING units only). However, the balance of the tactical wheeled vehicle fleet is employed throughout the theater, usually under conditions far less stringent than those found in the extreme forward areas.

(2) The majority of all tonnage entering any sizeable theater of operations is delivered by ships and distributed throughout the theater in bulk, predominantly by tractor-trailer highway transport. As shown in Table III-1, the trailer and load significantly reduce the cross-country capability of the tactical wheeled vehicles used in the theater-wide distribution role. Recognizing this fact, it is evident that the effective accomplishment of the distribution mission in a theater of operations requires that the surface lines of communication (LOC) be maintained so that cross-country movements are minimal. If this requirement is accomplished, commercial or derated tactical wheeled vehicles can readily be used to perform major portions of the distribution task.



NOTE—Percentages are derived by rating the function of each vehicle in over 600 TOE.

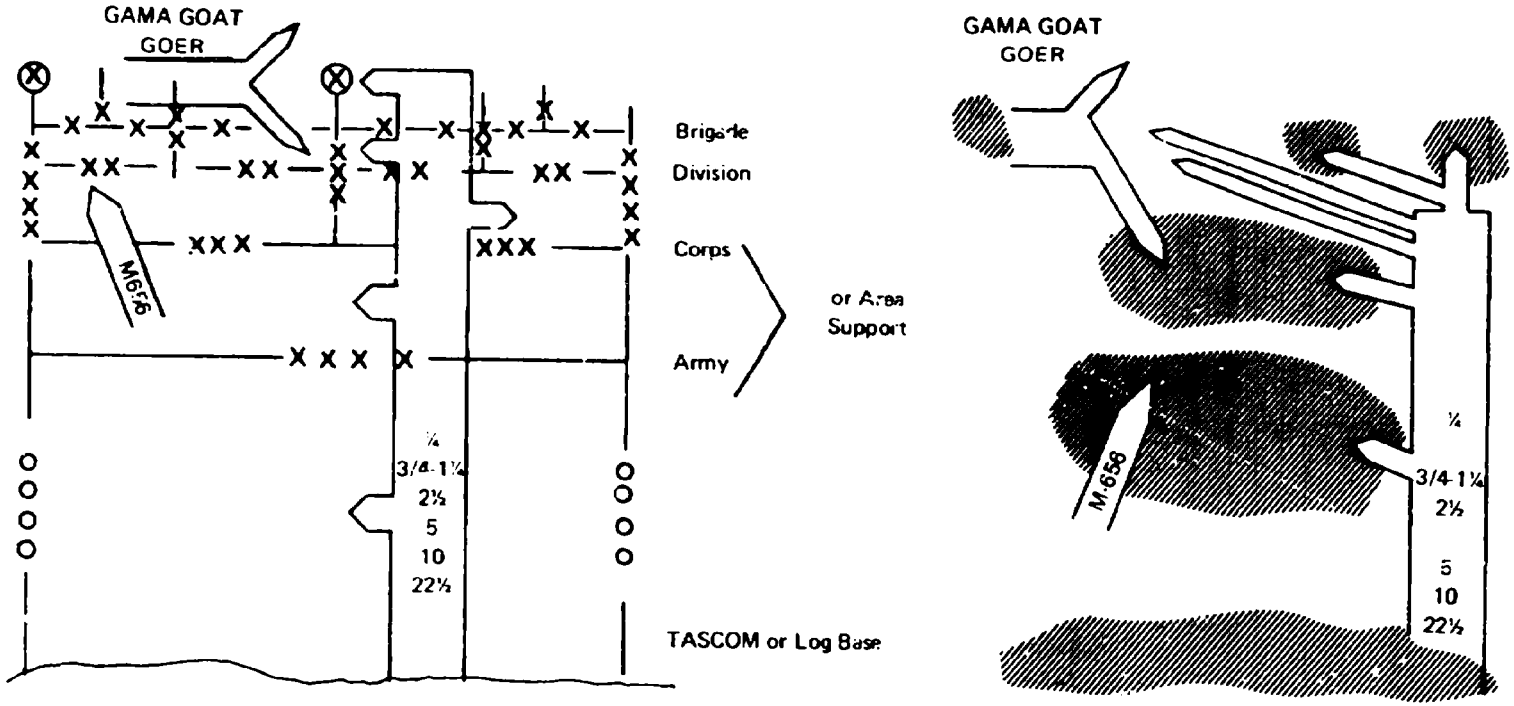
1 Excludes approximately 7000 5-ton trucks planned for replacement by commercial models in TOE units.

2 High mobility: Ability to perform extensive cross-country, rough-terrain operation.

3 Conventional mobility: Ability to perform occasional cross-country, rough-terrain operation.

4 Low mobility: Ability to perform on highways and secondary roads with infrequent off-road operation over selected terrain.

FIGURE III-1. MOBILITY REQUIREMENTS OF THE TACTICAL VEHICLE FLEET ("BIG 4" ABT)



High Mobility	Conventional Mobility
1/4-ton*	1/4-ton*
1 1/4-ton GAMA GOAT	3/4 - 1 1/4-ton
5-ton M656	2 1/2-ton
8-ton GOER	5-ton
	10-ton
	22 1/2-ton

*Fills both high- and conventional-mobility requirements due to ability to be lifted across water obstacles by GOER, M-656, or helicopter.

FIGURE III-2. CURRENT AREAS OF OPERATIONS FOR TACTICAL WHEELED VEHICLES

Analysis of the effort required to overcome LOC obstacles in Europe in support of U.S. forces indicates that the requisite engineer support is available from forces in-being and is well within the capabilities of present and proposed equipment. Use of the LOC for movement and throughput of the bulk of all required tonnages provides the necessary priority to protect and maintain such roads in order to facilitate rapid movement as an essential element of mobility. The cross-country movement of conventional tactical wheeled vehicles is so slow and subject to so many natural hazards that it is considered infeasible to attempt support of any sizeable force over considerable distances involving extensive off-road operations.

(4) The characteristics built into wheeled vehicles used in the theater-wide distribution role should afford the capability of bypassing obstacles by going off-road as opposed to operating extensively cross country. A comparison of data shown in lines 6 through 9 of Table III-1 shows that an improvement in off-road capability is possible by substituting a standard commercial tractor having additional power. This added power capability also would benefit road performance and allow the handling of containerized loads that are currently beyond the capability of the present military tractor.

(5) All of these considerations lead to the requirement for a closer review of the entire wheeled vehicle fleet structure, which currently provides a basically comparable degree of cross-country capability (except swimming) to all vehicles assigned to a theater. The ability to operate in the ground-gaining and close support environment demands the application of the best available means to overcome obstacles and provide tactical vehicle support to foot and track-laying units generally operating forward to the brigade rear boundary. The second area, generally from the division rear boundary forward to the brigade rear boundary, allows more freedom of action for vehicles, but may require cross-country support of forward units. The third area, generally from the division boundary to the rear, must provide for rapid vehicle movement forward and requires only limited and intermittent off-road capabilities. This latter area provides the basis for reviewing the characteristics of tactical wheeled vehicles with a view toward reducing capabilities in consonance with less demanding operational environments.

3.3.2 Specific Vehicle Characteristics Challenged

The characteristics for all tactical wheeled vehicles were reviewed along with the rationale and justification for each. This was

TABLE III-4
MILITARY VEHICLE CHARACTERISTICS CHALLENGED

Characteristic	Rationale
Adverse Terrain Capability	Centered on front-wheel drive not being essential to overcome extreme vertical obstacles because of route options and engineer capability available to the rear of division forces.
Deep-Water Fording	Route selection and LOC availability to vehicles out of ground-gaining environment makes this expensive characteristic unnecessary.
Electromagnetic Interference Suppression	Modification of over 180,000 trucks to reduce emissions to standards more stringent than commercial SAE requirements is unnecessary with current radio and sensor technology.
24-Volt Lighting System	The 12-volt lighting system is less expensive to procure and maintain, and should be adopted on military vehicles. However, industry is moving toward a 24-volt starting system for heavy trucks that should be retained for the starting and radio systems in tactical wheeled vehicles.
Winching Capability	Availability of recovery vehicles, and route preparation and selectivity available to support vehicles operating out of ground-gaining environment have overcome the need for proliferation of this capability.
Tarpaulin, Bows, and Curtains	This capability, now standard, should be optional for vehicles not engaged in troop movements. Military cargo packaging improvements offer numerous possible reductions.

accomplished to determine potential candidate features for removal from vehicles assigned to units operating out of the severe forward environment. The purpose of the removal of these challenged characteristics is to provide a less expensive vehicle that will function within the standard support system, but still will be capable of providing the required support to units operating behind the division boundary. A list of the characteristics challenged is shown in Table III-4. Many other items, including specific features on every tactical vehicle, were challenged to determine their associated fleet costs. No definable costs could be established for many of the challenged items because, in competitive bid fixed-price contracts, the component costs are not clearly established and estimated incremental increases or decreases for low dollar value items are not considered useful. The items that were considered most significant in the challenge process, in terms of potential savings and impact on fleet restructuring, are detailed in subsequent paragraphs, using estimated cost impacts provided by USATACOM. Removal of these characteristics creates basically three fleets of vehicles in a theater of operations:

- A high-mobility element operating principally in the ground-gaining and fire support environment
- A conventional-mobility group operating in environments requiring occasional cross-country movement
- A low-mobility (derated) fleet operating primarily on prepared road surfaces and only infrequently off-road over selected terrain.

The resultant total fleet creates a potential problem in the theater distribution of assets during wartime to satisfy possible large losses of conventional-mobility vehicles in the division and brigade areas, because a derated tactical wheeled vehicle could fill such losses only with a degradation in mobility capability. To resolve this distribution problem, the requirements for derated tactical wheeled vehicles have been calculated using Initial Issue Quantity (IIQ) only, and procurement of these types of vehicles would include only these IIQ requirements plus those vehicles required to satisfy the normal peacetime loss rate. The wartime loss rate would be calculated and the required vehicles procured in the conventional-mobility configuration. Thus, if losses to the rear of the division were above those anticipated, conventional-mobility vehicles would be available as replacements with no loss in mobility capability, and these same types of vehicles would

be available to fill the unexpected losses in the division and forward areas. As both vehicles—the conventional and derated tactical—are the same except for the removal of selected features, their maintenance and supply support is only minimally affected.

3.3.2.1 Adverse Terrain Capability

The primary consideration in this challenge was centered on removal of the expensive features that provide vertical obstacle climbing capability to all military vehicles. This capability is seldom provided on commercial counterparts because of cost and infrequent use. Generally, this derating involved removal of the powered front axle, the transfer case, and associated powertrain components.

3.3.2.2 Deep-Water Fording

This challenge envisions the removal of the waterproof igniter, starter, and alternator, and the replacement of these with standard commercial components. Vehicles with such modifications would be capable of 10 to 40 inches of fording, depending on the model, but basically would be splashproof as opposed to waterproof. Asset and dollar impacts are shown in Tables III-5 to III-8.

3.3.2.3 Electromagnetic Interference Suppression

This challenge involves the substitution of commercial items that meet Society of Automotive Engineers (SAE) standards for the ignition leads, distributors, windshield wipers, turn signals, and spark plugs that now have military specification shielding. Asset and dollar impacts are shown in Tables III-5 to III-8.

3.3.2.4 Change 24-Volt to 12-Volt Lighting System

This modification would apply to all tactical vehicles and require only that the current 24-volt electrical system used for all systems on the vehicles be changed to provide 12-volt lighting. There would be no change in the 24-volt starting or radio circuits. Asset and dollar impacts are shown in Tables III-5 to III-8.

3.3.2.5 Reduction in the Number of Winches

An estimated 50-percent reduction in the number of winches built into vehicles of the Army's tactical wheeled vehicle fleet may be achieved through a more stringent application of AR 310-34. This reduction is based on the availability of truck wreckers in units that have substantial numbers of trucks and rely on engineer support for route preparation, combined with recognition and use of prepared surfaces for support wreckers operating out of the ground-gaining environment. Asset and dollar impacts are shown in Tables III-5 to III-8.

3.3.2.6 Reduction in Tarps and Bows

An estimated 20-percent reduction in the equipping of the Army's tactical trucks with tarps and bows may be achieved fleetwide under this challenge. This reduction is based on elimination of the requirement for tarps and bows for trucks not engaged in troop movements on a repetitive basis. The capability provided by tarps and bows, which are now standard, should be made optional. Additionally, improvements in the packaging and containerization of cargo of all types have substantially reduced the requirement for tarps and bows to be standard items of issue for Army trucks. Asset and dollar impacts are shown in Tables III-5 to III-8.

3.4 SPECIAL QUALITATIVE CONSIDERATIONS

(1) The orderly development of a tactical wheeled vehicle possessing features that relate to the overall scheme of user needs

and fleet planning requirements has been periodically interrupted in the past by unforeseen events. The development of a 1 1/4-ton replacement for the 3/4-ton truck is an example of such an interrupted program. Cancellation in 1971 of the M705 (1 1/4-ton) program, in the combat development process since 1964, and the subsequent decision to not procure the proposed alternate vehicle (the M715E1) have created a condition that must be addressed as an exceptional situation requiring consideration outside the normal pattern for the tactical wheeled vehicle development and decision process. This specific problem has been subjected to intensive management decision processes by the Army Secretariat and Staff principals over the last year. The direction provided thus far includes approval of a plan for the USAMC Project Manager (PM) to procure a replacement vehicle (designated the XM852), using development funds only to improve the reliability, availability, maintainability, and durability (RAM-D) characteristics of the selected vehicle. Basic design of such a vehicle is to be accomplished by the USAMC PM through the use of a parametric analysis of existing military and commercial components that meet the minimum essential military requirements for vehicles in this weight class. Further restrictions were imposed to permit design using a performance specification that will provide a quasi-military vehicle, but without extensive development or procurement of a technical data package.

(2) One source of problems related to this follow-on vehicle has been the restatement of the Materiel Need (MN) by USACDC. Restatement of the requirement in a revised MN document was necessary because the vehicle developed to meet the original specifications (the XM705) contained features not met by another candidate (the M715E1) that, at the same time, was deemed capable of meeting the essential military requirements for this type of vehicle. Some of the more significant design differences between the XM705 and the M715E1 included (XM705 data shown first):

- A ground clearance of 11.0 inches versus 9.5 inches
- A 3-man versus a 2-man cab
- An angle of approach of 60 degrees versus 48 degrees
- An angle of departure of 45 degrees versus 26 degrees
- A cruising range of 300 miles versus 231 miles
- A cargo area of 55 square feet versus 41 square feet.

These design differences and the test data comparison, which indicated that the XM705 should provide better RAM-D characteristics, led to the attempt to synthesize the two areas by the developer in hopes of providing a vehicle with less stringent design characteristics but with improved supportability capabilities.

(3) The synthesis of these characteristics and capabilities, together with the expenditure of development funds authorized only to improve RAM-D characteristics, should logically result in the procurement of a vehicle consisting primarily of components existing in the military inventory or commonly available on the commercial market. Attempts to interest commercial industry in producing such a vehicle, with the limited development funds available, will lead to procurement of a predominantly off-the-shelf commercial vehicle. Within the context of the definition of a "commercial vehicle" stated in Section V, Annex D

, this vehicle is a prime candidate for commercial vehicle replacement in a 4 x 4 and 4 x 2 configuration and for use where mobility requirements are less stringent. Quantitative reductions in the 1 1/4-ton payload requirements allow application of the high-mobility GAMA GOAT to all Active Army units operating forward of the brigade rear boundary and to selected units in the division area. This is as specified in the currently approved Complete Basis of Issue Plan (CBOIP) after considering WHEELS quantity reductions. Sufficient quantities of GAMA GOAT vehicles will remain to permit distribution to selected Reserve component units having high-mobility requirements. The CBOIP for the GAMA GOAT fully meets the intent of the high-mobility concept, which is not challenged by WHEELS. However, because current procurement quantities of this vehicle are not sufficient to permit uniform application to all Active Army and Reserve component units, it is necessary to selectively distribute the GAMA GOAT to those Reserve component units having the highest likelihood of deployment. The high-mobility needs not filled by such distribution can be satisfied through use of existing 3/4- or 1 1/4-ton conventional-mobility assets until these wear out or are replaced by GAMA GOAT vehicles acquired from added production. Commercial 4 x 4 and 4 x 2 models potentially could fill the remaining Army needs if such trucks prove satisfactory in meeting mobility and supportability requirements. One additional consideration in meeting requirements for 1 1/4-ton trucks is the substitution of conventional-mobility 2 1/2-ton trucks rendered excess as a result of WHEELS and associated reductions.

3.5 CURRENT PRODUCT IMPROVEMENT PROGRAMS

(1) The qualitative characteristics of the tactical vehicle fleet are continually subjected to product improvement efforts devoted to the correction of deficiencies detected during field operations. The current vehicle product improvement programs (PIP) were reviewed to ensure compatibility with the goals of the WHEELS Study efforts. These efforts were essentially oriented to effect compliance with revised Federal emission, safety, and power standards, and to improve RAM-D factors. There are, with three exceptions, no changes envisioned that are in conflict with the WHEELS Study effort to reduce qualitative characteristics to minimum essential levels. The three exceptions are explained in the subsequent paragraphs.

(2) The first and major exception is the consideration of automatic transmissions for 1/4-, 2 1/2-, and 5-ton use, if they are cost effective. Automatic transmissions have higher initial acquisition costs than manual systems and generally cause consumption of added fuel. The truck industry is providing the major development effort in meeting future engine emission standards and advises that increased fuel consumption is a probable result of meeting these stringent standards. Such added costs and increased fuel consumption militate against a change in transmissions until the full results of emission designs can be evaluated.

(3) The second exception concerns a program to improve the 10-ton tractor. No production is presently planned for the 10-ton tractor. The potential exists to significantly reduce requirements for this vehicle when the Heavy Equipment Transporter (HET) enters the inventory. Similarly, significant reductions are possible depending on the result of a recommendation for replacing over 6,000 5-ton tractors with 8-ton tractors to accommodate the heavier loads associated with large containers.

(4) The third exception relates to rescheduling the remaining PIP effort to later dates in consonance with projected Program Objective Memorandum (POM) buys as the result of reductions in requirements made by WHEELS and DA Staff efforts.

3.6 CONCLUSIONS

(1) The roles, missions, and tasks of the tactical wheeled vehicle fleet embrace three levels of mobility. These levels derive

from the relative degree of unexpected movement over unimproved surfaces, and a further degree that would require maneuverability (as opposed to movement) over unimproved surfaces. These levels are best described as:

- Tactical High Mobility—The highest level of mobility designating the requirement for extensive cross-country maneuverability characteristic of operations in the ground-gaining and fire support environment.

- Tactical Standard Mobility—The second highest level of mobility designating the requirement for occasional cross-country movement.

- Tactical Support Mobility—A level of mobility designating the requirement for infrequent off-road operations over selected terrain with the preponderance of movement on primary and secondary roads.

(2) A tactical wheeled vehicle program, with objectives oriented to the three levels of mobility, should be prepared as a basis for structuring the qualitative content of the mid- and long-term tactical fleet.

(3) Basic to development of the mid- and long-term program is the requirement to develop mission and performance envelopes for various vehicle roles, missions, and tasks within each of the levels of mobility.

(4) Implementation of the vehicle program may require research and development, product improvement, and/or changes to vehicle specifications that provide the basis for production contracts.

(5) Determination of the level of mobility requirements of units is a function of the combat development processes (i.e., doctrine and organizational development, materiel requirements documents, Basis of Issue Plans, and TOE changes).

(6) Vehicles determined necessary for the tactical support mobility role do not require selected design features that are necessary for vehicles in the tactical standard and tactical high-mobility roles. These design features are listed on the following page.

- Adverse Terrain Capability—Centered on front-wheel drive not being essential to overcome extreme obstacles because of route options and engineer capability available behind division forces.

- Deep-Water Fording—Route selections and lines of communication (LOC) available to vehicles out of the ground-gaining/fire support environment make this characteristic unnecessary.

- Electromagnetic Interference Suppression—Commercial SAE standards are adequate in view of current radio and sensor technology.

(7) The 24-volt lighting system should be abandoned for all vehicles in favor of a 12-volt system.

(8) Winching capabilities should be provided for only approximately 50 percent of the current tactical fleet requirements; specific identification of vehicles requiring winches should be a function of the combat development process.

(9) Tarpaulins, bows, and curtains should not be provided for vehicles not engaged in troop movements. Packaging improvements negate the need for further protection for cargo. Specific identification of vehicles requiring these items should be a function of the combat development process.

(10) Commercial- and military-design vehicles are candidates for filling vehicle requirements in any of the levels of mobility; determination of adequacy is a function of the combat development process. (See Annex D and Appendix 1 to Annex G.)

(11) The AMC-71 Ground Mobility Model provides a satisfactory means for differentiating between vehicle capabilities and for orienting the design and application of vehicle resources against the mobility capabilities required by the Army in-the-field.

3.7 MAJOR POLICY RECOMMENDATION

The tactical wheeled vehicle program objective will be oriented to three general levels of mobility.

(1) Tactical High Mobility—The highest level of mobility designating the requirement for extensive cross-country maneuverability characteristic of operations in the ground-gaining and fire support environment.

(2) Tactical Standard Mobility—The second highest level of mobility designating the requirement for occasional cross-country movement.

(3) Tactical Support Mobility—A level of mobility designating the requirement for infrequent off-road operations over selected terrain with the preponderance of movement on primary and secondary roads.

3.8 OTHER RECOMMENDATIONS

(1) Establish goals designed to achieve a minimum essential capability in each of the three mobility classes in the Army wheeled vehicle program to:

(1.1) Serve as a basis for structuring the qualitative content of the mid- and long-term tactical fleet.

(1.2) Develop mission and performance envelopes for various vehicle roles, missions, and tasks.

(1.3) Determine research and development, product improvement, or other changes to vehicle specifications to provide the basis for production contracts.

(1.4) Orient the doctrine and organizational development, Materiel Requirements document production, Basis of Issue Plans, and TOE changes to integrate such goals.

(2) Provide vehicle candidates to fill the tactical support role with a non-powered front axle, commercial splashproof water protection, and commercial SAE standard electromagnetic interference suppression.

(3) Modify the entire fleet for 12-volt lighting, reduce approximately one-half of the current winch requirements, and reduce the issue of tarpaulins and bows by placing these items on an "issue on demand only" basis for vehicles engaged in troop movements.

(4) Subject the AMC-71 Ground Mobility Model to continuing refinement efforts with the objective of using it as a tool in the vehicle management process.

CHAPTER IV

COMMERCIAL VEHICLE STUDY

4.0 GENERAL

(1) This largely empirical study examines the degree to which the Army can expand its use of commercial vehicles as substitutes for the more-costly military-design tactical vehicles, without adversely affecting combat capability. The study is made against a backdrop of questions uniquely sensitive to the use of commercial vehicles (i.e., mobility, capability, cost, mobilization effects, multiplicity of makes and models (standardization), warranties, leasing, buyback, and supportability). Special consideration is given to alternative logistic support concepts in recognition that this area is most critical if the Army is to capitalize on the apparent cost savings to be generated by using commercial vehicles in selected roles and missions.

(2) A significant element of the study is the definition of commercial vehicles, which includes the qualification that, for procurement purposes, the item and regular production options must be available to the civilian market, and must have proven acceptance over a period of time, as evidenced by the continuing demand by the civilian market. This definition is the basis for two important aspects of the study:

- The Army's vehicle requirements could be satisfied in a more economical manner by taking advantage of active commercial production lines.
- The test and evaluation associated with research, development, and procurement of military-design vehicles would not be necessary, because the proven acceptability of the item to the civilian market over a given period of time is, in itself, "test and evaluation."

4.1 RECENT EXPERIENCE IN COMMERCIAL VEHICLE UTILIZATION

(1) There are two primary concerns addressed in the consideration and evaluation of commercial vehicles presently being used by the Army. They are:

- The ability of the commercial vehicle to perform as well as its standard military counterpart
- Commercial vehicle support during wartime.

(2) During World Wars I and II, the Army relied on commercial vehicles. However, widespread proliferation of makes and models severely complicated repair parts supply. During the Korean conflict, military-design vehicles were introduced, and in the middle to late fifties, the Army adopted the current family of military vehicles as standard (i.e., M151-series 1/4-ton truck, M37-series 3/4-ton truck, M44-series 2 1/2-ton truck, and the M39-series (recently changed to M809-series) 5-ton truck). In Vietnam, the Army had in hand a standardized fleet that performed well when put to the test, although there were some notable exceptions.

(3) One such exception was the 5-ton tractor. In a line-haul role, this vehicle pulls the M127 semitrailer with loads up to 18 tons or a 5,000-gallon tanker. It was soon apparent that the LDS-465 multifuel engine that powered the M39-series 5-ton tractor was not sufficiently durable for this duty cycle. As engines failed at disturbingly low mileage, the theater stockage of engines was consumed and the airlift of engines from CONUS to Vietnam became necessary. It was then decided that a suitable commercial engine should be procured and installed in all new production 5-ton trucks. The vehicle manufacturers competing for the end-item production contract selected the engine they felt was most suitable from a list of qualified candidates chosen by the Army. Engines were selected for inclusion in the listing on the basis of the engine being appropriately rated and having been sold in quantity over the past 2 years. Because there was no time for lengthy development and/or test programs, the assumption was made that the Army could rely on the sophistication and experience of the commercial fleet operator, who is the principal customer in the heavy-duty engine market. Kaiser Jeep (now AM General Corporation) won the contract and selected the Cummins NHC 250. When this engine appears in the M39-series chassis, the vehicle is redesignated the M809-series in the 5-ton truck family.

(4) Another exception was the 5-ton military-design dump truck. This vehicle did not fail to perform, nor did it cause a parts problem; it merely did not perform as well as commercial vehicles in the hands of the construction contractors who were working in Vietnam. For example, the 5-ton dump truck was too small for the major road construction tasks. Therefore, several military drivers were required to do the work of one driver operating a commercial truck. Some commercial dump trucks were later procured for use by engineer units engaged in the line of communication (LOC) restoration program. Though there were some initial deficiencies in these vehicles and in the necessary logistic support arrangements, they were generally accepted as improvements over the military standard 5-ton dump trucks.

(5) There are other examples in which commercial vehicles were used successfully in Vietnam. Kenworth trucks were effectively used and supported at the Cam Rahn Bay logistical complex. Dodge 1-ton trucks were procured and issued to both Vietnamese and U.S. forces in lieu of the military Standard B 1 1/4-ton M715 truck.

Commercial vehicles were also used extensively by contractors operating in the theater. For example, Han Jin, a Korean firm engaged in port clearance, relied on Japanese trucks.

(6) For the past 7 years, the 37th Transportation Group has been operating a fleet of approximately 900 commercial tractors in Europe. This fleet was purchased in 1965 to replace the military standard M52 tractors and has been accumulating mileage at a rate of 25 million miles per year. During the year 1972, another contract was awarded to International Harvester Company (IHC) for replacement vehicles. The 37th Transportation Group favors the commercial tractor in lieu of the military standard tractor for this application.

(7) In addition to the light tractors issued to the 37th Transportation Group, a 25-ton tractor was also issued to U.S. Army, Europe (USAREUR), for interim use as a tank transporter. This commercial vehicle was procured from IHC, and after a shaky start with more than the usual logistic support problems, the vehicle now enjoys a high availability rating. During the 8-month period from July 1971 to February 1972, availability ratings were 90 percent or above, with the exception of January when the availability was 85 percent.

(8) As of 1 April 1972, there were 50,930 commercial trucks operating in Tables of Distribution and Allowances (TDA) units. Commercial trucks are, for the most part, favored by commanders for administrative transport functions at posts, camps, and stations. However, the Study Group found some 5,000 military vehicles engaged in these functions, and recommended that authorizations for these vehicles be withdrawn and that suitable commercial vehicles be substituted in their stead.

4.2 HIGH-POTENTIAL CANDIDATES AS SUBSTITUTES FOR TACTICAL VEHICLES

(1) Several high-potential candidates were identified as suitable substitutes for their military standard counterparts in selected applications. Shown below are five specific types of commercial vehicles that can fill current requirements on a cost-effective basis:

- A 20-ton dump truck to replace the current military standard 5-ton dump truck in selected engineer units of the Active and Reserve Forces. This requirement has been approved. (See Chapter II, paragraph 2.1.2.1, REVA 3.)

- A heavy-duty tractor, capable of hauling high-density containerized cargo, to replace the current military-design 5-ton tractor used in line-haul transportation units in both the Active and Reserve Forces. During the period from July 1971 to February 1972, 70 percent of dry cargo arriving in Europe by sealift was containerized. This requirement has been approved. (See Chapter II, paragraph 2.1.3.5, REVA 23.)

- A commercial 3/4 - 1 1/4-ton truck to fill the low-mobility role in units not equipped with the high-mobility M561 GAMA GOAT. The adoption of a suitable commercial vehicle in this payload would nullify the current requirement for the development of the M852, a 1 1/4-ton vehicle with performance requirements ranging somewhere between those of the XM705 and the M715E1. Qualitative aspects were addressed in Chapter III, paragraph 3.4.

- A commercial tractor and semitrailer to haul engineering construction equipment in lieu of both the more expensive military-design heavy equipment transporter (HET) and the current military-design 10-ton tractor and 25-ton semitrailer. This commercial equipment is preferred for engineer units, which normally operate behind the division rear boundary, in large part because it can clear underpasses without difficulty. The heavy-duty tractor candidate identified previously will be considered for this role to haul engineer loads of 35 tons and below. A larger commercial tractor and semitrailer will be considered to haul engineer loads greater than 35 tons.

- Deletion of the requirement to transport engineering construction equipment from the HET mission will permit a re-examination of the stated requirements for HET. Cost analysis and comparative evaluation of the military tractor, a derated version of the military tractor, and a composite commercial candidate will provide decision factors for determining utilization of a commercial tractor in the tank transporter role.

(2) It should be noted that these vehicles are generally used for logistic and administrative type transport. None of these trucks is found in ground-gaining combat units. Except for the 3/4 - 1 1/4-ton truck and, to a degree, the tank transporter, the proposed substitutions will not normally operate forward of the division rear boundary. In the case of the 3/4 - 1 1/4-ton truck, the Army obtained highly satisfactory service from the old Dodge M37, which was essentially a modified commercial vehicle. Furthermore, in those units requiring the rugged cross-country vehicle, the GAMA GOAT is available.

(3) All of these candidates share one characteristic in common—they are competing with military vehicles that, for one reason or another, require suitable replacements. The current 5-ton truck tractor is not suitable for moving maximum container payloads. The 5-ton dump truck is not cost effective for selected engineer units when driver costs are computed. The Army plans to phase-out both the M37 and the M715. Replacement of the current tank transporters and tractors used to move engineer construction equipment is necessary to meet the power levels required.

4.3 ALTERNATIVE FLEET MIXES

The WHEELS Fleet Model was used to postulate alternative fleet mixes with commercial vehicles in a variety of potential roles, and to estimate fleet quantities and life-cycle costs for the various alternatives. Tentative commercial substitutes competed against military standard vehicles under a variety of assumptions. The U.S. Army Engineer Waterways Experiment Station (USAEWES) and the U.S. Army Tank-Automotive Command (USATACOM) provided performance factors developed as part of the U.S. Army Materiel Command ground-mobility research program for both commercial and military vehicles. These performance factors reflect the ability of the vehicles to traverse typical terrain conditions in priority geographical areas. The WHEELS Fleet Model was extremely useful in quantifying, to the extent possible, cost and performance of the alternative fleet mixes. The model has been used for the 1 1/4-ton commercial truck. (See Section IV, Annex D, Volume II.) The estimated savings resulting from the introduction of this truck are between $150 million and $274 million over the truck's life cycle. Further exercise of the model is planned for Phase III of the WHEELS Study.

4.4 EXPERIENCE OF COMMERCIAL FLEET OWNERS

(1) One element of the study addressed the commercial practice of common carriers and other specialized haulers. Onsite interviews were conducted with 15 fleet managers. Representatives of the WHEELS Study Group and the U.S. Army Materiel Systems Analysis Agency conducted the interviews, on both the east and west coasts, with both large and small operators who were engaged in a variety of activities. One operator works in all 50 States and routinely runs over the Alaskan highway. Another hauls cattle and operates over all types of roads, including trails and open fields. Another operator hauls ready-mix concrete to construction sites, and still another transports new automobiles on high-speed highways. A Study Group member observed equipment used in logging operations on both the west coast and in New England, and noted that logging equipment carries heavy loads over steeply graded trails that are either muddy or dusty and around tight curves, in all kinds of weather, without the benefit of all-wheel drive.

(2) People who make their living by operating trucks focus on availability. When equipment is not available for work, revenue is lost and sometimes customers are tried beyond their patience. Most operators cannot afford the luxury of spare equipment. Records are maintained on individual vehicles, and "shop queens" are sold or traded-in.

Increases in fuel and oil consumption rates are indications that major repairs are in the offing and the big operators are keenly aware that maintenance costs go up and availability goes down as equipment accumulates age and mileage. Tax advantages also accrue when truckers, who can afford it, buy new equipment.

(3) Commercial fleet operators are choosy when it comes to acquisition. Some lease because they want to avoid the maintenance problem and find more time for the revenue-producing end of the business. Those who buy, stay with tried and proven components. They select engines and powertrain components that suit their needs. Few select front-wheel drive as an option, preferring a tandem axle with limited slip differentials. One large firm buys on a competitive basis, but specifies engine, transmission, and axles, in addition to other options. Commercial fleet operators are also restrained by Government regulations that limit the size of equipment used on public highways. One operator said that he would like to see these regulations changed, and if they were, he would buy new equipment. In Nevada, one tractor is allowed to pull three trailers. The cab-over-engine or cab forward is popular because the trailers that carry the payload can be longer (up to 65 feet in overall length of the combination). One carrier wants his tractor to be lightweight so that he can get more payload registering on the scales and less dead weight.

(4) Fleet owners maintain detailed cost records, and would like to reduce labor costs in particular. All strive to reduce the labor content in their operation, which is a lesson that should not be ignored by the Department of the Army because this is directly related to efforts now being made to reduce the logistical tail.

(5) Warranty enforcement is no problem to the commercial fleet owner because of his close personal relationship with the seller, a relationship that does not pertain to the Army and the low bidder. (Army procurement procedures know no product loyalty.) Buying proven components, backed up by a tried and proven warranty, also has the advantage of allowing the operator to be reasonably sure that parts and maintenance service will be readily available throughout the United States. By trading early, the large firms are not confronted by parts obsolescence.

(6) Another interesting finding uncovered during these interviews with fleet operators was their attitude toward assignment of drivers. They do not universally assign drivers to specific vehicles.

For many firms, it appears that current policy is to keep the vehicle on the road earning revenue by employing relay drivers. Some operators complained that their drivers abuse the vehicle as much as an Army driver. Operators prefer experienced drivers, or drivers who have graduated from a recognized professional driver school.

4.5 COMMERCIAL VEHICLE PROCUREMENT

(1) The study addressed the truck manufacturing industry and identified four separate truck markets, broken down by gross vehicle weight (GVW) and defined as light, medium, heavy, and extra-heavy. The 1971 sales of trucks in the light category exceeded 1.6 million units; and in the extra-heavy category (trucks with a GVW of more than 26,000 pounds), 147,000 units were sold. Medium and heavy truck sales were 91,000 units and 132,000 units, respectively.

(2) While the light and medium truck markets are dominated by the Big Three automotive producers, IHC is a major competitor of the Big Three in the heavy category. In the extra-heavy category, Chrysler's influence wanes, while IHC, Ford, and GM share that market with Mack, PACCAR, and several others.

(3) The extra-heavy truck market is highly sophisticated with large manufacturing concerns selling primarily to large trucking concerns. Most of the trucks in this class are made to customer specifications, and, to a large extent, the manufacturers are assemblers of parts that are both chosen and supplied by others, although they encourage the use of their own parts. In addition to encouraging the use of parts manufactured by themselves, the truck manufacturers also encourage the use of a more standard truck to take advantage of production line efficiency. Their efforts have not met with much success because trucking firms have carefully analyzed their costs down to fractions of a cent per mile, have developed their preferences over a long period of time, and do not like to change a successful truck configuration. The "assembly to customer specifications" nature of extra-heavy truck production has probably accounted for the success of the independent truck manufacturers in competition with the large automobile manufacturers, because the latter are more attuned to mass production techniques. The major automobile producers have only 36 percent of the extra-heavy market.

(4) Relatively few suppliers serve the extra-heavy truck industry. Major suppliers include Cummins Engine Company, the world's largest independent supplier with 40 percent of the 1971 market. Other

diesel engine producers (with percent of total 1971 sales shown in parentheses) are Detroit Diesel, division of GM (32.6 percent); Mack, a division of the Signal Companies (15.4 percent); Caterpillar (8.9 percent). Axles are produced by Rockwell and Eaton; transmissions by Dana, Fuller, Eaton, Clark, and Mack.

(5) Acting on an official request from the Department of the Army, the American Ordnance Association assembled a committee composed of automotive representatives to assist the WHEELS Study effort. The committee was provided with a list of specific questions and a scenario. Two meetings were held, one in Washington and the other in Detroit. The industry's view regarding areas of interest is summarized as follows:

- Capability To Produce End Items and Spare Parts for a Mixed Fleet. The industry has capacity to produce 9 million cars and trucks per year. Under mobilization conditions, it would be easier to divert commercial production of end items and parts to the military than it would be to retool a commercial assembly line to produce military standard vehicles and parts.

- Standardization and Fleet Renewal. Best advantage of commercial products can accrue by not standardizing. Thus, procurements should be on a continuing basis and not in large buys. However, recognition was given to the alternative that the Army's study of logistic systems could support a requirement for standardization. In such a case, there was general agreement that the best way to achieve standardization is a buy-out of the total quantity of a specific body style in one model year.

- Resale Value of Used Vehicles in Large Lot Sizes. The industry marketing people were not upset at the prospect of accepting large lots (5 to 10 thousand) of used vehicles from the Army in overseas locations. One representative indicated that there is a growing market for used commercial vehicles in developing nations.

- Spare Parts Through Manufacturers' Overseas Outlets. Spares could be supplied from existing

commercial sources with proper planning for worldwide support in both peacetime and under mobilization conditions.

- Utility of Warranties. Industry does not feel that vehicles for the military require a warranty, except in CONUS, but they will provide any warranty the customer wants. However, the customer must read the fine print and be prepared to pay for it.

- Impact of Emission Control Standards and Safety Standards on Commercial and Military Vehicles Procured by the Army. Industry is obliged to ensure that standards are met on commercial vehicles, and spreads the cost over total sales. The Army must reduce emissions from its own engines and bear the full cost, unless purely commercial engines are selected.

- Gold-plating. Industry representatives agreed that it is the function of the producer to meet the customer's demand and not tell him what he should buy. Value engineering is not highly regarded.

- RAM-D and Testing. Industry must produce an acceptable vehicle that is reliable and durable. If the customer is too dissatisfied and has an alternative, he stops buying and the item is forced off the market. Also, the expense associated with recall campaigns further inhibits manufacturers from sacrificing quality in high volume commercial production.

(6) Study Group members also visited Kenworth Truck Company, Seattle, Washington; Freightliner Corporation, Portland, Oregon; and AM General, South Bend, Indiana. Kenworth and Freightliner are extra-heavy manufacturers. AM General produces trucks for the Government (Army and Post Office) as well as a line of commercial vehicles such as Jeeps and Gladiators.

(7) The Armed Services Procurement Regulation applies to Army truck procurements, whether military or commercial. Standardization is achieved when military vehicles are procured because the vehicle is described in detail in the technical data package. No

matter who submits the winning bid, the vehicle is nearly identical with items previously procured using the same technical data. In contrast, commercial vehicles can be standardized by buying out specific body styles under performance specifications and trading in the replaced vehicles, as suggested by the industry representatives. Piecemeal procurement will result in a proliferation of makes and models that could strain the supply system. The key to the introduction of commercial vehicles into the Army supply system is some proof of acceptance by the general public. Recent significant sales within the past 2 years are an indication of product acceptance. Also, analysis of commercial fleet owners' experience and operating costs is an important element as opposed to lengthy test programs. When procuring the extra-heavy vehicles, the Army should precisely specify approved components as it did in the replacement for the 5-ton truck multifuel engine. There are no legal or administrative constraints that would prevent the Army from procuring commercial trucks in lieu of military standard trucks.

(8) Although military standard vehicles are retained in service for extended periods of time, commercial vehicles should be retained only so long as spare parts are readily available from commercial sources, and should be traded-in while physical life (and resale value) remains. Since the entire fleet of a specific body style will be the same age at the same time, the economic life of the vehicle in the Army should expire before major overhaul is required and while the vehicle enjoys a high availability rate.

(9) The procurement of commercial vehicles also has significant impact on the requirement computation. Specifically, commercial vehicles have a continuous hot base and relatively high-volume production when compared with production rates of military vehicles. This condition permits procurement to the hot base Authorized Acquisition Objective (AAO), and there are other potential savings. For example, the production rate for light trucks is about 1.6 million per year, a rate sufficient to meet a substantial portion of the AAO within a short period of time.

(10) Commercial vehicles also open the door to leasing opportunities. For example, certain Reserve training requirements could be filled with leased vehicles, to be replaced with new vehicles after M-day and before scheduled deployment. Leasing has special significance when the vehicles under consideration are the 1 1/4-ton truck and the heavy-duty tractor for line-haul units. In the case of the 1 1/4-ton truck, high-volume production is available to fill a large requirement. In the case of the tractor, low-volume production is available to fill a smaller requirement for units with a lower priority.

4.6 ALTERNATIVE METHODS OF LOGISTIC SUPPORT

(1) Five alternative means of logistically supporting commercial vehicles were investigated in terms of their cost and effectiveness under both peacetime and wartime conditions. They were:

- The standard Army support system
- A special supply system that uses manufacturers' parts numbers for non-Federal stock number (NFSN) items, reduced stockage, and direct shipment from vendors to requisitioning units (basically the current Defense Supply Agency's (DSA) NFSN system for commercial vehicles)
- The use of Contractor Operated Parts Stores (COPARS) overseas or in conjunction with a Theater-Oriented Depot Complex (TODC)
- Consolidated maintenance for commercial vehicles assigned to both TOE and TDA units at European Equipment Maintenance Centers (EMCs)
- Leasing.

Support of TOE units in Europe was selected for special attention to ensure appropriate consideration of transportation, stockage, and mobility ramifications. Leasing was quickly rejected as an alternative because of operational and cost disadvantages.

(2) The four remaining alternatives all appeared feasible in peacetime. Based on current Air Force experience, COPARS was judged to be highly responsive, particularly where supported units are located in a small geographic area with limited mobility requirements for intermediate level supply activities. Current DSA tests that indicate a NFSN system can operate with a 38-day order shipping time (OST) attest to the viability of a special supply system. The EMCs are providing satisfactory maintenance support at present and could accommodate a higher density of commercial vehicles.

(3) Wartime considerations (e.g., personnel turbulence, disrupted LOC and mobility) argued strongly in favor of the use of the standard Army system. Other alternative support systems appeared

to have several potential disadvantages. Many of these were subjective in nature (e.g., lack of confidence in contractors' ability to perform effectively in a hostile environment and unavailability of air movement capability in an emergency).

(4) Cost analyses indicated that COPARS was the least-cost solution in only a few special situations. On the other hand, the special system alternative was often slightly less expensive than the use of the standard Army system. Cost spreads, however, were minimal, with most differentials within the error possibility of the study.

(5) The overall assessment was that the standard Army system represented the most attractive method for supporting commercial vehicles assigned to TOE units. Further studies will be required to provide the additional quantification needed to justify the use of alternative support concepts in special situations.

4.7 CONCLUSIONS

(1) Commercial vehicles can perform with a high degree of Army user satisfaction, can be supported, and are cost effective. (See Chapter V, this volume, and Sections III and VIII, Annex D, Volume II.)

(2) The major concern of senior officers is that the commercial vehicle must be supported within the framework of the standard Army supply and maintenance system. (See Section III, Annex D, Volume II.)

(3) There are commercial vehicles that outperform their military counterparts in certain applications and for which there is a valid user requirement. (See Section IV, Annex D, Volume II.)

(4) A proliferation of makes and models will result unless procurement, disposals, and replacements are carefully planned. This proliferation could cause the collapse of the repair parts supply system in an emergency. (See Section II, Annex D, Volume II.)

(5) Commercial vehicles assigned to TOE units should be procured through an accelerated acquisition process, but can be supported through the standard Army support system using technical manuals, Federal stock numbers, and maintenance allocation charts, after an appropriate degree of initial provisioning. (See Section VIII, Annex D, Volume II.)

(6) Further studies are required to substantiate or reject alternative means of logistically supporting commercial vehicles in special situations. These studies should be performed during the 1972-1974 period, before new acquisition decisions must be made. (See Section VIII, Annex D, Volume II.)

4.8 MAJOR POLICY RECOMMENDATIONS

Because many commercial vehicles are capable of adequately performing selected functions in Army units, they will be considered as candidates in any analysis of tactical vehicle requirements. Generally speaking, demonstrated marketability eliminates the need for Army testing.

4.9 MAJOR IMPACT RECOMMENDATIONS

(1) Have the ACSFOR, in conjunction with the CG, USAMC, and CG, USACDC, conduct a critical analysis of the Heavy Equipment Transporter (HET) development program, and report the results with recommendations to the WHEELS Steering Group. (The currently scheduled IPR for type classification should be deferred pending Steering Group assessment of the analysis.) The analysis should specifically, but not exclusively, address the:

- Validity of the current requirements document.
- Availability and ability of commercial tractors and semitrailers to satisfy requirements to haul heavy engineer equipment loads and/or tank loads.
- Impact of potential increased requirements due to the introduction of larger commercial construction equipment such as the T-11/T-12 size dozers.
- Adequacy of proposed corrections to hardware deficiencies in the XM746 tractor as reported by the Test and Evaluation Command.
- Results of an ongoing (USATACOM) comparative evaluation of the XM746 tractor, a "derated" XM746 tractor, and commercial candidate tractors.
- Results of an ongoing (USATACOM) cost analysis of the XM746 tractor.

(2) Terminate the 1 1/4-ton XM852 program and authorize 1 1/4-ton commercial vehicles for all 1 1/4-ton applications other than those requiring a high-mobility vehicle.

4.10 OTHER RECOMMENDATIONS

In addition to the major recommendations listed in the preceding section, the following recommendations pertaining to commercial vehicles are also made and included below for ready reference.

(1) Relating to the commercial 20-ton dump truck:

(1.1) Type classify the commercial dump truck as Standard A for selected engineer units, both Active and Reserve.

(1.2) Prepare a separate P-20, compute logistic factors, and carry item as a separate line in the P-1.

(1.3) Procure the same make and model (or source specify maintenance significant components) for counterpart Reserve units.

(2) Relating to the 8-ton commercial truck tractor:

(2.1) Approve for DA staffing the Materiel Need (Abbreviated), in Annex D, Volume II, for commercial truck tractors for selected applications as prepared by WHEELS. Consideration should be given to source specification of maintenance significant components and to the total system requirement, to include container chassis, semitrailers, and necessary materials-handling equipment for container operations.

(2.2) Prepare a separate P-20, compute logistic factors, and carry item as a separate line in the P-1.

(3) Relating to the commercial 1 1/4-ton truck:

(3.1) Cancel further efforts to design and/or develop a military standard 1 1/4-ton truck (XM852). Establish a requirement for commercial 1 1/4-ton 4 x 4 and 4 x 2 trucks to fill the 3/4 - 1 1/4-ton tactical support and tactical standard requirements.

(3.2) Prepare a separate P-20, compute logistic factors (giving full recognition to high-volume production rates), and carry item as a separate line in the P-1.

(3.3) Eliminate all M37 and M715 vehicles as the commercial 1 1/4-ton truck enters the inventory.

(4) Relating to the tractor and semitrailer used to haul engineer construction equipment:

Establish a requirement for a 35-ton commercial construction equipment low-bed semitrailer to provide an adequate means to transport heavy construction equipment. This item should be compatible with the military-design 10-ton truck tractor (or the product-improved 5-ton tractor) as well as the proposed heavy-duty commercial truck tractor planned to replace both the 5-ton and 10-ton tractors in selected applications.

(5) Relating to acquisition and support:

(5.1) Develop and promulgate a regulation and/or pamphlet that describes an abbreviated acquisition process to be used for general- and special-purpose commercial vehicles being procured for TOE units.

(5.2) Support new commercial vehicles logistically with the standard Army support system. Maximum use will be made of Direct Supply Support (DSS) procedures, with no stockage of repair parts above direct support levels.

(5.3) Continue to support administrative-use (TDA) commercial vehicles through the special supply system (MFR manuals, limited stockage, FSNs, and MPNs).

(5.4) Consider COPARS on a case-by-case basis, concentrating on CONUS and small, compact overseas applications (e.g., USARSO).

(5.5) Compute Authorized Acquisition Objectives for commercial vehicles in tactical roles on the same basis as for tactical vehicles, but recognize the continuous high-volume commercial production in the computation of production offset. During Phase III, the WHEELS Study Group will further study the potential for constraining procurement of commercial vehicles to minimize stockage.

CHAPTER V

VEHICLE SELECTION PROCESSES

5.0 GENERAL

The foregoing discussions of the quantitative, qualitative, and commercial vehicle factors that impact on the total vehicle fleet highlight the need for methods of fleet selection that provide for variations in force structure, tasks within the structure, and characteristics of the vehicle candidates. In analyzing vehicle selection processes, alternative fleets were selected based on commercial and tactical wheeled vehicle "shopping lists" developed by the WHEELS Study Group. The shopping lists provided the broad range of vehicles to be considered for inclusion in the fleet. The WHEELS Fleet Model provided the tool for comparison of the alternatives by applying cost data, vehicle performance, capability requirements, unit mobility requirements, and mission objectives. Based on such comparisons, vehicles that best fulfilled all stated objectives were selected. This chapter describes the methodologies used in developing candidate vehicle shopping lists, cost computations, economic life, and computer modeling.

5.1 VEHICLE CANDIDATES—COMMERCIAL AND TACTICAL WHEELED VEHICLE SHOPPING LISTS

A listing of tactical and commercial wheeled vehicle candidates has been prepared to facilitate the identification of the alternative vehicles available (see Table V-1). The primary considerations used in developing the list were the weight, size, and capability of the candidate vehicles. Each vehicle selected was subjected to a detailed investigation of specific design characteristics. These characteristics were then put into the AMC-71 Ground Mobility Model (see Section 5.3.1) to evaluate on-road and off-road capabilities of the vehicle being considered. The acquisition, operation, and peripheral support costs were gathered for each vehicle candidate and introduced into the WHEELS Fleet Model (see Section 5.3.2) to provide system costs and comparisons based on selected fleet composition rules. The total purpose of compiling a vehicle candidate list in this manner is to provide a basis for substitution of one vehicle or group of vehicles into the current tactical wheeled vehicle fleet, thereby allowing for the development of broad vehicle requirements estimates.

TABLE V-1

ALTERNATIVE VEHICLES AVAILABLE

No.	Vehicle		Trailer/Howitzer	
	Description	Designation	Description	Designation
	Category 1: 1/4-Ton Payload			
1.	Truck, utility, 1/4-ton, 4 x 4	M151A2	None	
2.	Truck, utility, 1/4-ton, 4 x 4	Commercial	None	
3.	Truck, utility, 1/4-ton, 4 x 2	M151A2	None	
4.	Truck, utility, 1/4-ton, 4 x 2	Commercial	None	
5.	Truck, utility, 1/4-ton, 4 x 4	M151A2	Trailer, cargo, 1/4-ton, 2 wheel	M416
6.	Truck, utility, 1/4-ton, 4 x 4	Commercial	Trailer, cargo, 1/4-ton, 2 wheel	M416
7.	Truck, utility, 1/4-ton, 4 x 2	M151A2	Trailer, cargo, 1/4-ton, 2 wheel	M416
8.	Truck, utility, 1/4-ton, 4 x 2	Commercial	Trailer, cargo, 1/4-ton, 2 wheel	M416
	Category 2: 1/2-Ton Payload			
9.	Truck, platform, utility, 1/2-ton, 4 x 4	M274A2	None	
	Category 3: 3/4-Ton Payload			
10.	Truck, cargo, 3/4-ton, 4 x 4	M37B1	None	
11.	Truck, cargo, 3/4-ton, 4 x 4	M37B1	Trailer, cargo, 3/4-ton, 2 wheel	M101A1
	Category 4: 1 1/4-Ton Payload			
12.	Truck, cargo, 1 1/4-ton, 4 x 4	M715E1	None	
13.	Truck, cargo, 1 1/4-ton, 4 x 4	XM705	None	
14.	Truck, cargo, 1 1/4-ton, 6 x 6	M561	None	
15.	Truck, cargo, 1 1/4-ton, 4 x 4	Commercial	None	
16.	Truck, cargo, 1 1/4-ton, 4 x 2	M715E1	None	
17.	Truck, cargo, 1 1/4-ton, 4 x 2	Commercial	None	
18.	Truck, cargo, 1 1/4-ton, 4 x 4	M715E1	Trailer, cargo, 3/4-ton, 2 wheel	M101A1
19.	Truck, cargo, 1 1/4-ton, 4 x 4	XM705	Trailer, cargo, 3/4-ton, 2 wheel	M101A1
20.	Truck, cargo, 1 1/4-ton, 6 x 6	M561	Trailer, cargo, 3/4-ton, 2 wheel	M101A1
21.	Truck, cargo, 1 1/4-ton, 6 x 6	M561	Howitzer, Light, 105 mm	M102
22.	Truck, cargo, 1 1/4-ton, 4 x 4	Commercial	Trailer, cargo, 3/4-ton, 2 wheel	M101A1
23.	Truck, cargo, 1 1/4-ton, 4 x 2	M715E1	Trailer, cargo, 3/4-ton, 2 wheel	M101A1
24.	Truck, cargo, 1 1/4-ton, 4 x 2	Commercial	Trailer, cargo, 3/4-ton, 2 wheel	M101A1
	Category 5: 2 1/2-Ton Payload			
25.	Truck, cargo, 2 1/2-ton, 6 x 6	M35A2	None	
26.	Truck, cargo, 2 1/2-ton, 4 x 2	Commercial	None	
27.	Truck, cargo, 2 1/2-ton, 6 x 4	M35A2	None	
28.	Truck, cargo, 2 1/2-ton, 6 x 6	M35A2	Trailer, cargo, 1 1/4-ton, 2 wheel	M105A2
29.	Truck, cargo, 2 1/2-ton, 6 x 6	M35A2	Howitzer, light, 105 mm	M102
30.	Truck, cargo, 2 1/2-ton, 4 x 2	Commercial	Trailer, cargo, 1 1/2-ton, 2 wheel	M105A2
31.	Truck, cargo, 2 1/2-ton, 6 x 4	M35A2	Trailer, cargo, 1 1/2-ton, 2 wheel	M195A2

TABLE V-1 (Continued)

No.	Vehicle		Trailer/Howitzer	
	Description	Designation	Description	Designation
	Category 6: 5-Ton Payload			
32.	Truck, cargo, 5-ton, 6 x 6	M813	None	
33.	Truck, cargo, 5-ton, 8 x 8	M656	None	
34.	Truck, cargo, 5-ton, 6 x 4	Commercial	None	
35.	Truck, cargo, 5-ton 6 x 4	M813	None	
36.	Truck, cargo, 5-ton, 6 x 6	M813	Howitzer, 155-mm	M114A1
37.	Truck, cargo, 5-ton, 8 x 8	M656	Howitzer, 155-mm	M114A1
38.	Truck, cargo, 5-ton, 6 x 4	Commercial	Trailer, gross towed load: 12, 700 lb	Commercial
39.	Truck, cargo, 5-ton, 6 x 4	M813	Trailer, gross towed load: 12, 700 lb	Commercial
	Category 7: 8-Ton Payload			
40.	Truck, cargo, 8-ton, 4 x 4	M520E1	None	
	Category 8: 5-Ton Tractor With 12-Ton, 2-Wheel Trailer			
41.	Truck, tractor, 5-ton, 6 x 6	M818	Semitrailer, stake, 12-ton, 4 wheel	M127A1C
42.	Truck, tractor, 5-ton, 6 x 4	Commercial	Semitrailer, 12-ton, 4 wheel	M127A1C
43.	Truck, tractor, 5-ton, 6 x 4	Commercial	Semitrailer, 12-ton, 4 wheel	M127A1C
44.	Truck, tractor, 5-ton, 6 x 4	M818	Semitrailer, low bed, 25-ton, 4 wheel	M172A1C
	Category 9: 10-Ton Tractor With 25-Ton, 4 Wheel Trailer			
45.	Truck, tractor, 10-ton, 6 x 6	M123A1C	Semitrailer, low bed, 25-ton, 4 wheel	M172A1
46.	Truck, tractor, 10-ton, 6 x 4	Commercial	Semitrailer, low bed, 25-ton, 4 wheel	M172A1
	Category 10: 22 1/2-Ton Tractor With 52 1/2-Ton Trailer			
47.	Truck, tractor, 22 1/2-ton, 8 x 8	XM746	Semitrailer, low bed, HET, 8 wheel, 52 1/2-ton	M747
48.	Truck, tractor, 22 1/2-ton, 8 x 4	Commercial	Semitrailer, low bed, HET, 8 wheel, 52 1/2-ton	M747

5.1.1 Tactical Wheeled Vehicle Candidates

All standard and special-purpose tactical wheeled vehicles presently in the system have been listed as candidates to fill their own current requirements. In addition, all standard items of equipment in the system that contain a tactical wheeled vehicle as a component have been identified and listed as candidates to fill the current requirement.

5.1.2 Commercial Vehicle Candidates for the Administrative Fleet

All standard and special-purpose commercial vehicles presently in the system have been listed as candidates to fill current requirements. These requirements primarily are confined to Tables of Distribution and Allowances (TDA).

5.1.3 Derated Tactical Wheeled Vehicles

A list has been prepared of utility and cargo tactical wheeled vehicles that have had selected components removed and, as a result, are considered candidates to fill requirements. As described in Chapter III, the principal features considered to be excessive on tactical wheeled vehicles that require less stringent mobility and operational capability within selected areas of a theater of operations include adverse terrain capability (front-wheel drive), deep-water fording, and electromagnetic interference suppression. Additionally, there are other features that can be removed or modified on all or a portion of the tactical wheeled vehicle fleet. For example, lighting systems can be changed from 24-volt to 12-volt, approximately 50 percent of the winches can be removed, and tarpaulins, bows, and curtains for something on the order of 20 percent of the cargo vehicles can be eliminated.

5.1.4 Commercial Vehicle Candidates for Tables of Organization and Equipment Substitutions

(1) Commercial vehicles selected as substitutes for Tables of Organization and Equipment (TOE) authorized tactical wheeled vehicles have the same gross vehicle weight (GVW) as their military counterparts. Since the curb weight (CW) of the commercial vehicle is in most cases less than the military version, a greater payload capacity can be credited to the commercial. However, the cargo volume is essentially the same for both and is considered the limiting factor. The result is that a rugged vehicle has been selected as the commercial candidate instead of the lightest possible version.

(2) All candidate vehicles at or above the 2 1/2-ton payload category are powered by diesel engines. This decision is necessary to permit a straight comparison of diesel-powered military commercial vehicles rather than create the large weight and cost advantage that would accrue to a gas-powered candidate if it were being compared with a diesel-powered tactical wheeled vehicle.

(3) The selection of a commercial candidate confirms that military vehicle characteristics and performance levels can be duplicated without making a specific make and model recommendation. Once the determination has been made to acquire commercial vehicles, the user's needs will be stated in specification form and industry-wide proposals will be solicited.

5.2 COST COMPUTATION METHODOLOGY

The methodology for cost computation in support of the WHEELS Study can be separated into three distinct areas of development:

- A foundation of basic cost assumptions
- A common base of specific cost elements, identified to permit cost summarization and comparison of competing candidate vehicles
- An examination of existing lifetime values and determination of the values to be used in the WHEELS Fleet Model.

5.2.1 Basic Cost Assumptions

The following key assumptions and guiding criteria are basic to the costing computations used in the WHEELS Study:

(1) All costs to be expressed in constant FY 72 dollars.

(2) Costs of emission control modifications to be based upon the 1972 Federal emission control standards.

(3) Annual and 12-year life-cycle costs will be developed for a total fleet requirement and individual candidate commercial/derated military vehicles.

(4) A type classification Standard A military vehicle will be costed for each weight and body type classification. A Standard B

military vehicle will be costed only when there is no Standard A vehicle.

(5) The annual replacement quantity for each vehicle will be determined by dividing the Authorized Acquisition Objective (AAO) by the useful life.

(6) Configuration changes will not influence useful life.

(7) The useful life of a candidate commercial vehicle considered for substitution in the military fleet will be the same as that of the military vehicle it is replacing.

(8) Product improvement program histories will be reviewed for the development of an annual recurring cost to be charged to the individual vehicle cost.

(9) The percentage of tactical vehicles requiring overhaul will be determined from historical records and a projection for the next 5 years.

(10) The depot overhaul of vehicles will be costed in the least-cost mode, assuming redistribution of vehicles in the same theater of operation where the overhaul occurs.

(11) Only the full-time drivers will be charged to the vehicle's life-cycle costs.

(12) Personnel costs for maintenance and crew will be based on an average annual worldwide salary plus support costs and a man-hour availability rate of 1,450 man-hours per year.

(13) R&D product improvement costs prior to FY 73 are considered sunk.

(14) Vehicles costed in this study will not be phased out during the postulated 12-year life cycle.

5.2.2 Identification of Specific Cost Elements

(1) The cost elements considered in this study were specifically developed to display costs for the current tactical wheeled vehicle fleet and to be used in cost comparisons involving the candidate

commercial and derated tactical wheeled vehicles. Particularly important is the inclusion of the "retail" costs associated with stockage, storage, and issue, which normally have not been considered in other costing methodologies.

(2) The costing for derated and commercial candidate vehicles differs in certain respects from that for the tactical wheeled vehicle fleet. In general, derated candidates show incremental costs due to the derating process. Also, support costs for commercial and derated candidate vehicles are based on the premise that these vehicles must be supported through the standard military supply system and that an increase in support costs is applicable for new line items added to the system. A detailed explanation of each element is presented in Annex E, Volume II.

(3) The following elements were used in the cost comparisons developed for this study:

- Development
  - Research and development
  - Product improvement
- Investment
  - Unit hardware
  - Federal excise tax and transportation
  - Initial provisioning, to include Federal excise taxes and transportation
  - Line item introduction
  - Investment support (includes engineering support to the production contract, test and evaluation, and USATACOM support)
- Operation
  - Repair parts
  - Maintenance labor

- Overhaul
- Petroleum, oil, and lubricants
- Integrated logistic support management—wholesale (includes USATACOM support management and supply depot operations)
- Integrated logistic support management—retail (includes installation supply operations, and direct support and general support stock, storage, and issue).

5.2.3 AR 37-18 Comparison

The preceding breakout of cost elements has been adapted specifically to fit the needs of WHEELS. However, a comparison of WHEELS cost inputs to AR 37-18 has been made to ensure that all cost elements have been considered. The detailed definition of the WHEELS cost elements is contained in Annex E, Volume II.

5.2.4 Economic Life

The relationship between life-cycle costs and vehicle lifetimes (the cost/life relationship) is particularly important when comparing and evaluating vehicles. The basic cost factors have been outlined in the preceding sections. Once these cost factors have been determined and the various analyses initiated, the lifetime assigned to a vehicle becomes significant. It is the lifetime that determines the number of years over which total vehicle cost can be spread, thereby influencing the relative cost of the vehicle being considered. Because of its importance, the selection of economic life inputs to the WHEELS Fleet Model was given careful consideration, and the results of this effort are summarized in this section.

5.2.4.1 Definitions

(1) Reference sources use a number of important terms, sometimes interchangeably, when dealing with the relationship between life-cycle costs and vehicle lifetimes. For the purpose of clarification, a review of the primary reference sources was conducted, and an effort was made to identify and, where necessary, to modify the more frequently used terms.

(2) The definition of economic life is particularly important. DOD Instruction 7041.3 defines economic life as: "The period of time over which the benefits to be gained from a project may reasonably be expected to accrue to the Department of Defense." This definition raises contradictory connotations, since benefits can accrue well after it is uneconomical to retain the item. The relationships between cost and retention, which are vital to replacement decisions and, in a larger sense, to fleet management, require a term that takes cognizance of economic decision points. For this reason, WHEELS has modified the definition of economic life, a key term for purposes of this report, to stress the aspect of including all costs. These cash flow parameters include nonavailability, obsolescence, maintenance, operation, acquisition, provisioning, overhaul, transportation, salvage, and opportunity, to cite a few. The new definition is included in the following paragraph.

(3) The definitions listed below were derived from various Army source documents, or developed and adopted by the WHEELS Study Group as being the most appropriate to vehicle management.

- Economic Life—The estimated period during which it is economical to retain an item in the system while considering all elements in the cash flow, including the costs of nonavailability and opportunity. The economic life of an item is determined by the interaction of many changeable parameters and, therefore, is not a fixed value. (Source: WHEELS Study Group.)

- Physical Life—The estimated period (years, miles, hours) that an item can physically be used in accomplishing the function for which it was designed, constructed, and procured. (Adapted from DODI 7041.3.)

- Technological Life—The estimated period (years, miles, hours) before technology will make available new equipment or facilities that will make the existing or proposed equipment or facilities obsolete. (Adapted from DODI 7041.3.)

- Design Life—The planned period (years, miles, hours) identified by the developer (normally in the ROC or its equivalent) that an item will function

satisfactorily, given certain specified limits and criteria. Design life is a function of engineering. (WHEELS Study Group.)

- Program Life—An estimate, utilized for replacement programming purposes, of the average period (years, miles, hours) an item will remain in use prior to replacement. In the most cost-effective system, the average economic life for an item equals the program life; however, resource constraints can preclude this. (WHEELS Study Group.)

- Shelf Life—The estimated period that perishable products (e.g., canvas and rubber) or end items with perishable components can be stored and still retain their intended physical life. (WHEELS Study Group.)

- Replacement Life (also called Service Life)—The actual period (years, miles, hours) that an item was used prior to replacement regardless of the reason therefor. In a completely rational system, average replacement life = program life = average economic life. (WHEELS Study Group.)

- Useful Life—Not adopted. Can be confused with a number of other definitions.

- Use Age—Period (years, miles, hours) that an item has been in service or in the hands of using activities. (Adapted from AR 310-25.)

- Age—A period determined by factors that significantly stress the particular component (or system) and potentially cause degradation or deterioration of the component. Thus age may involve a combination of things such as months of storage, months of use, miles traveled, hours of operation, and number of cycles (e.g., start-up cycles). (WHEELS Study Group.)

- Maintenance Expenditure Limit—The maximum expenditure permitted for one-time repair of a vehicle at direct support and/or general support maintenance.

It includes the cost of repair parts and labor service. Unserviceable vehicles with repair cost exceeding the maintenance expenditure limits are classified as uneconomically repairable. (Adapted from TB 750-98-23.)

- Overhaul—The process of restoring an item to the completely serviceable condition prescribed by maintenance serviceability standards (i.e., Depot Maintenance Work Requirements). This is accomplished by disassembling the item; inspecting the condition of its component parts; reassembling it using serviceable or new assemblies, subassemblies (modules), and parts; and performing an inspection and operational test. (Reference AR 750-1.)

- Rebuild—The process of restoring an item to a standard as near as possible to original or new condition in appearance, performance, and life expectancy. This is accomplished by complete disassembly of the item, inspection of all of its parts or components, repair or replacement of worn or unserviceable elements using original manufacturing tolerances and specifications, and subsequent reassembly of the item. (Reference AR 750-1.)

5.2.4.2 Existing Lifetime Values

(1) An extensive survey of existing literature was made to identify all of the lifetimes that have been developed for each vehicle type. Table V-2 summarizes the results of the survey. The six sources identified, and the types of information they present, are:

- Army Materiel Plan (AMP) and Qualitative Materiel Requirement (QMR): deal with specific vehicles used within the Army

- AR 700-88: deals with general weight classifications of vehicles

- Technical Bulletin (TB) 750-98-23 (as modified in September 1971): deals with specific vehicles and provides a matrix of years-in-operation versus mileage

TABLE V-2
VEHICLE LIFETIMES DEVELOPED BY VARIOUS SOURCES

Type of Vehicle	AMP Life Years	QMR Mileages	AR 700-88		TB 750-98-23 (Revised 9/71)		USAF TO 36A-1-70		RAC Studies		WHEELS Computation
			Years	Miles	Years	Miles	Years	Miles	Years	Miles	Years
Tactical Vehicles											
1/4-ton ABT	8	20,000	6	72,000	12	60,000	8	84,000	7	50,000	6.66
1/2-ton P	10	4,000	—	—	—	—	—	—	—	—	4.00
3/4-ton ABT	12	20,000	6	72,000	12	60,000	8	84,000	10	—	9.25
1 1/4-ton ABT	12	12,000	7	84,000	14	70,000	8	84,000			9.25
1 1/4-ton HM	12	20,000	—	—	14	70,000	8	84,000	—	—	9.25
2 1/2-ton ABT	12	20,000	8	84,000	14	70,000	10	150,000	10	—	13.35
5-ton ABT	13	20,000	10	150,000	16	80,000	10	150,000	10	—	8.57
5-ton HM	10	20,000	—	—	16	80,000	10	150,000	—	—	17.32
8-ton ABT	12	25,000	10	150,000	16	80,000	10	150,000	—	—	10.71
10-ton ABT	12	10,500	12	300,000	16	80,000	12	300,000	—	—	9.03
22 1/2-ton HET	14	20,000	12	300,000	16	80,000	10	150,000	—	—	17.29
Commercial Candidates (Identified By GVW or GCW)											
3,500-lb AGVW			6	72,000			8	—			
9,000-lb GVW			7	84,000			8	84,000			
19,000-lb GVW			8	84,000			10	84,000			
41,000-lb GVW			10	150,000			10	150,000			
70,000-lb GCW			10	150,000			10	150,000			
85,000-lb GCW			12	300,000			12	300,000			
180,000-lb GCW			12	300,000			10	150,000			

Note:

ABT = All body types.
P = Platform.
HM = High mobility.
HET = Heavy Equipment Transporter.
AGVW = Adjusted Gross Vehicle Weight.
GVW = Gross Vehicle Weight.
GCW = Gross Combination Weight.

- U.S. Air Force (USAF) Technical Order (TO) 36A-1-70: deals with general weight classifications of vehicles

- Research Analysis Corporation (RAC) studies: deal with specific vehicles

- WHEELS Computation: divides QMR mileage by average annual mileage and deals with specific vehicles.

Table V-2 reveals considerable variation between sources concerning the years-of-life expected of different vehicles. This reflects the different factors used in developing the values, which in turn were intended for different purposes.

(2) A discussion of the derivation and validity of each lifetime value identified is contained in Annex E, Volume II. However, an insight into the tenuous nature of the lifetime values can be obtained by tracing the development of the AMP lifetimes for the 2 1/2-ton all body type (ABT) tactical wheeled vehicles (listed as 12 years in Table V-2).

(3) The original AMP value (10 years) was derived in a study completed by RAC in 1961. After using this value for a limited period of time, managers within the Department of the Army (DA) believed that more consideration should be given to the different uses of vehicles in Reserve versus Active Army units. The variance in the degrees of use should cause vehicles to have different life expectancies.

(4) A 50-percent increase in life expectancy was postulated as reasonable for vehicles used in Reserve units. Thus, the same vehicle might have a 10-year life in an Active Army unit, but an expected lifetime of 15 years in a Reserve unit. The assumption was then made that the vehicles in any one category within the present fleet were equally divided between Active Army and Reserve units. Thus, the 10-year life expectancy for the Active unit vehicles could be averaged with the 15-year life expectancy for those of Reserve units to produce 12 1/2-year life expectancy for all 2 1/2-ton vehicles. Since programming procedures do not accommodate half years, the decision was made to drop the half year, thereby resulting in the lifetime value of 12 years being assigned to the 2 1/2-ton truck in Table V-2.

(5) The 5-ton vehicle also had an original AMP life of 10 years. Thus, the same computations occurred for that vehicle. However, instead of dropping the half year, the lifetime value was arbitrarily assigned as 13 years.

(6) As should be obvious from the numerous assumptions and approximations used in the preceding computations, the final value for the AMP lifetime is not the precise, accurate value one might expect. Rationale for the other lifetime values shown in Table V-2 is equally tenuous and difficult to derive.

5.2.4.3 Selection of Values for Use in the WHEELS Fleet Model

5.2.4.3.1 Tactical Military Vehicles

(1) Consideration of all available data on the cost/life relationship leads to the conclusion that, with the exception of those few cases wherein a RAC study has addressed a specific vehicle, there is no disciplined basis for any of the currently postulated vehicle lives. Industrial practices cannot contribute to the selection of a lifetime because they vary widely from company to company and replacement decisions are normally based on specific cost data relevant to the given vehicle. In determining which life to specify for each vehicle in the WHEELS model, there are two alternatives: either develop a new lifetime value, or adopt an existing value.

(2) The option to develop a new and more accurate economic life value is much more desirable. However, the key element in replacement cost analysis is the variance in the costs with vehicle age, and this refinement is not available in existing data sources. A United States Army Materiel Systems Analysis Agency (USAMSAA) study is in the process of collecting such operating and maintenance data for certain vehicles, and will have these by late 1973. The use of a sophisticated replacement algorithm to develop a proposed lifetime value without these data would be pointless.

(3) With one exception, adoption of the AMP life for tactical vehicles in the WHEELS Fleet Model appears to be the best choice. Full acknowledgment is made of the absence of a disciplined basis for the AMP lifetimes. It is presumed that the processes of trade-off analysis and change, which are inherent in the pluralistic system of AMP development, have produced reasonable, although unsubstantiated numbers. In those cases where AMP lifetime exceeds the design lifetime as a result of changes in maintenance policy, the change will be

reflected in greater life-cycle costs occasioned by new maintenance requirements. The relatively large-scale comparisons made by the WHEELS Fleet Model will be valid using the AMP life as long as equivalent uses and lives are postulated for comparable vehicles. The Army management community is familiar with the AMP lives, and no purpose would be served by substituting another equally indefensible set of numbers.

(4) The one exception to the use of the AMP life is in the case of the 5-ton high-mobility vehicle. A general characteristic revealed in studying all of the various vehicle lives is that an increase in lifetime occurs with increased GVW. The current 10-year AMP life for the 5-ton high-mobility vehicle represents a discontinuity in this rule. The life of this vehicle is 2 years less than that of the 1 1/4-ton high-mobility vehicle. This probably results from the lack of visibility of the 5-ton vehicle in program exercises of recent years. Therefore, a lifetime comparable to that of the 5-ton ABT (i.e., 13 years) will be used for the WHEELS Fleet Model.

5.2.4.3.2 Commercial Candidates

A deliberate attempt has been made to select rugged commercial vehicles that would be equivalent to their military counterparts. The lives postulated in current military criteria for commercial-design vehicles are appropriate to the low-years, high-mileage use they currently undergo, but are inappropriate when applied to tactical fleet usage. Given a deliberate equivalency in other areas, the same lifetime value is indicated, insofar as possible, for commercial vehicles as for their tactical counterparts.

5.2.4.3.3 Inputs to WHEELS Fleet Model

The sensitivity of each WHEELS Fleet Model comparison to the life inputs will be considered on a case-by-case basis. If exceptions to the lives specified herein are indicated for a specific comparison, this will be highlighted when used. The lifetimes given in Table V-3 have been used as inputs to the WHEELS Fleet Model for tactical and derated wheeled vehicles and commercial candidates.

5.2.5 Recommendations:

(1) Subject to HQ, DA, staffing of the individual definitions, amend AR 310-25, "Dictionary of United States Army Terms," to include the definitions for life-cycle related terms adopted by WHEELS.

(2) Subject to joint staffing, amend DODI 7041.3, "Economic Analyses of Proposed Department of Defense Investments," to reflect the WHEELS definitions of economic life, physical life, and technological life.

TABLE V-3

WHEELS FLEET MODEL VEHICLE LIFETIMES

Tactical Vehicle	WHEELS Life Inputs (years)	Commercial Candidates (Identified by GVW or GCW)	WHEELS Life Inputs (years)
1/4-ton ABT	8	3,500 GVW	8
1/2-ton Platform	10		
3/4-ton ABT	12		
1 1/4-ton ABT	12	9,000 GVW	12
1 1/4-ton HM	12		
2 1/2-ton ABT	12	19,000 GVW	12
5-ton ABT	13	41,000 GVW	13
5-ton HM	13	70,000 GCW	13
8-ton ABT	12		
10- ton ABT	12	85,000 GCW	12
22 1/2- ton HET	14	180,000 GCW	14

5.3 STUDY MODELS

(1) Early in Phase I of the WHEELS Study, special attention was given to the identification and review of existing vehicle/fleet analytical models that might directly support WHEELS' analyses and objectives. Three models considered as possible supporting sources were:

- The AMC-71 Ground Mobility Model: A vehicle performance model for considering the combined effect of interactions between vehicle characteristics and terrain properties of selected operational environments
- The REVAL-WHEELS Model: An alternative vehicle fleet selection and life-cycle cost model

- The RAC Pooling Model: A simulation model for use in analyzing potential vehicle savings through the centralizations of selected transportation support functions and assets within specified areas of a type theater of operations.

(2) Because of the fleet reductions envisioned as a result of the U.S. Army Combat Developments Command (USACDC) Tactical Vehicle Review Board (TVRB) recommendations and the Recommended Vehicle Adjustments (REVA) developed during Phases I and II of WHEELS, the decision was made to defer use of the RAC Pooling Model until after assessment of Phase II study results. Since major use has been made of the other two models during Phase II of the study, the two models are described in the following sections.

5.3.1 The AMC-71 Ground Mobility Model

(1) The Army Materiel Command (AMC) - 71 Ground Mobility Model has been used to predict the relative performances of currently standard tactical wheeled vehicles, proposed derated models of these vehicles, and potential commercial vehicle substitution candidates. A total of 48 vehicle types have been analyzed on the basis of terrain data representative of three different geographical areas. Within each area, relative performances have been computed for a spectrum of operational modes ranging from completely cross-country to exclusively primary roads.

(2) In supporting the WHEELS Study effort, the AMC-71 Ground Mobility Model has been used and significantly modified by an ad hoc mobility panel consisting of technical representatives of the U.S. Army Tank-Automotive Command (USATACOM) and the U.S. Army Engineer Waterways Experiment Station (USAEWES). Relative vehicle performance data derived from the model have been furnished to the WHEELS Study Group subsequent to its evaluation by this panel. Where deemed appropriate, model results have been adjusted, based upon technical judgments of panel members and corroborating data, to enhance the quality and relative objectivity of the data. Vehicle performance data developed by this process have served as a major determinant in the development of Study Group vehicle substitution alternatives involving commercial and derated military vehicles.

(3) The AMC-71 Ground Mobility Model was jointly developed by USATACOM and USAEWES as part of their continuing mobility research programs. The basic concept embodied in the model is that

the performance of a vehicle at any moment is the result of a complex interplay of vehicle characteristics, terrain features, and driver-imposed elections and constraints. It is postulated that the maximum practical speed of a vehicle ("speed-made-good") over a particular terrain segment is a valid measure of the vehicle's mobility with respect to that terrain segment, with logical time penalties being assessed for immobilizing terrain conditions.

(4) In computing speed-made-good, the model considers a representative geographical area as a mosaic of terrain segments, each of which can be treated as uniform in terms of measurable factors affecting vehicle responses. Primary terrain factors considered by the model as influencing vehicle mobility include: soil strength, up-slopes and down-slopes, surface roughness, obstacle crossing and avoidance, stream crossing, obstacle override motion resistance, obstacle override shock loading, visibility, and interactions of the preceding with each other and vehicle characteristics. Special methods were developed to address on-road performance, stream crossing, vehicle ride, and obstacle dynamics, which were not handled adequately by the model to meet the particular WHEELS needs. Additional changes were made to meet requirements placed on the model by the examination of articulated as well as normal vehicles. Most noteworthy of these special methods were the use of simplified submodels for both ride and obstacle dynamics, and the treatment of articulated vehicles.

(5) Detailed diagnostics are provided as model outputs identifying the reason for a vehicle's less-than-100-percent performance in any terrain unit studied. Typical performance indices computed are:

- Average speed in all but the 10 percent worst areal terrain
- Percent of areal terrain the vehicle can negotiate without immobilization
- Average speed on secondary roads
- Average speed on primary roads (surfaced, two lanes or greater).

5.3.2 The REVAL-WHEELS and the WHEELS Fleet Models

(1) The REVAL-WHEELS Model is a computerized procedure for projecting alternative Army vehicle fleet requirements and impacts based upon proposed changes to current vehicle authorization policies and criteria. To avoid confusion, the model as revised and employed during the WHEELS Study effort is termed the WHEELS Fleet Model. In support of WHEELS, the WHEELS Fleet Model has been used:

- To provide an automated data base of standard TOE vehicle requirements for use in estimating, at unit and fleet level, the cumulative impact of the USACDC TVRB recommendations, WHEELS Phase I/Phase II REVA, and alternative vehicle substitution policies for the increased use of commercial and derated tactical wheeled vehicles within the Army

- To provide an automated summary-level, vehicle life-cycle cost data base for generating and displaying life-cycle cost impacts of proposed fleet reductions and substitution policies

- To provide visibility to selected Army tactical fleet characteristics to include the distribution of fleet requirements by vehicle type, by location within a type theater of operations, and by function supported.

(2) The model was originally developed during the 1968 DA study, Re-Evaluation of the Army Tactical Vehicle Program (REVAL-WHEELS). Significant changes to the model have been made to improve its applicability and utility to WHEELS needs. An overview of the general methodology incorporated in the WHEELS Fleet Model is illustrated in Figure V-1. Based upon standard TOE, vehicular task requirements are defined at the unit level and coded in terms of functional descriptions such as:

- Task function

- Relative mobility requirement

- Expected duration and frequency of vehicle usage

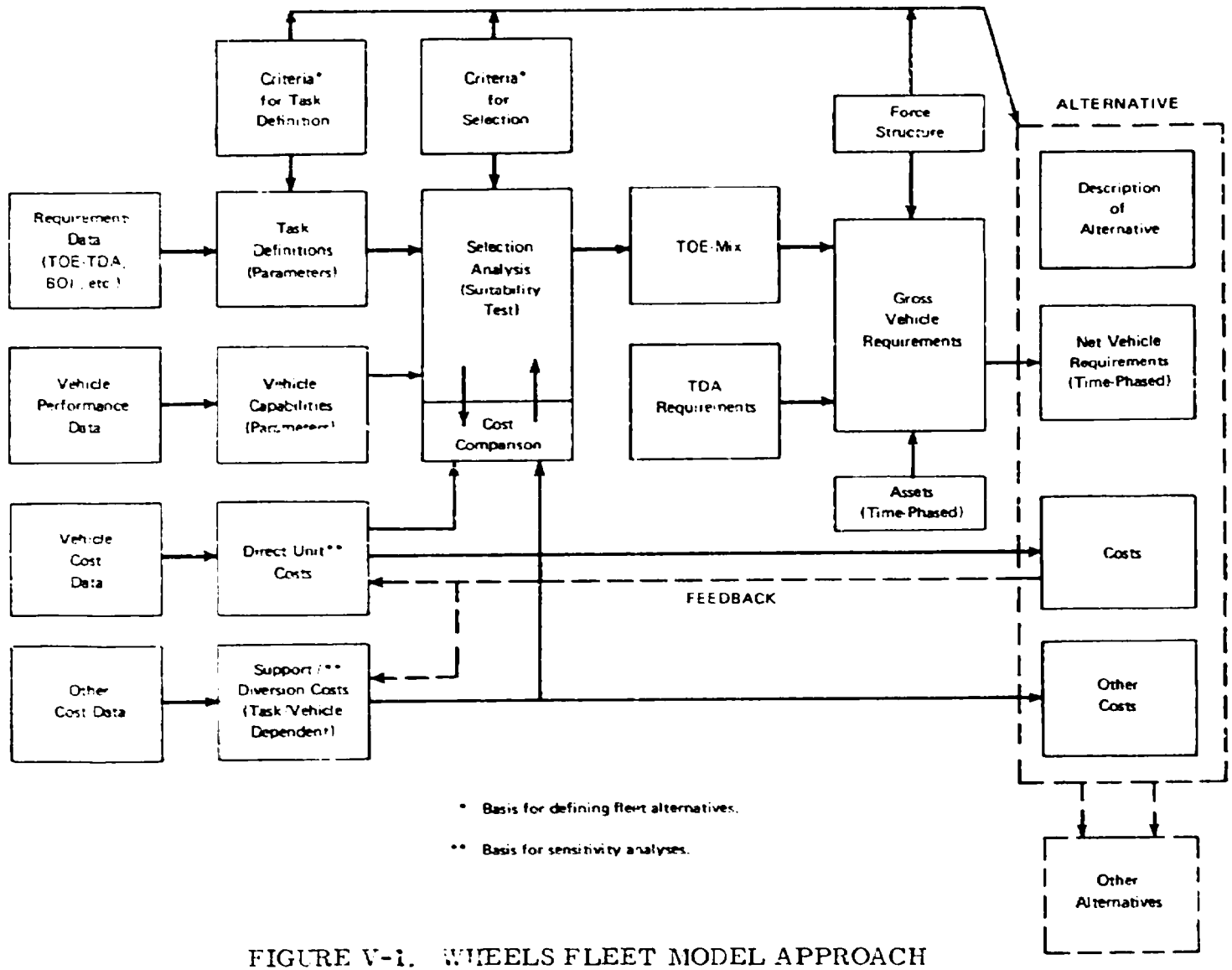


FIGURE V-1. WHEELS FLEET MODEL APPROACH

- Typical area of operations within a type theater of operations
- Body-style requirements (e.g., ambulance, wrecker, dump, van)
- Full-time assigned driver requirement
- Associated vehicle-mounted radios
- Currently authorized vehicle types.

(3) General vehicle performance and life-cycle cost data are also coded in parametric form and associated with 120 basic vehicle types, including current standard tactical wheeled vehicles, proposed derated military candidates, and proposed commercial vehicle substitution candidates. Criteria for vehicle deletions or substitutions are specified by the user in terms of selected task and vehicle parameters. These rules are sequentially applied by the model to all defined vehicular tasks. This process, coupled with task density information provided by force structure input data, permits the calculation of fleet vehicle requirements and costs by vehicle type. Model design facilitates the modification of data inputs (such as costs) to update prior alternatives or to perform sensitivity analyses.

(4) All data inputs to the model have been prepared under the supervision of the WHEELS Study Group. The types of data and the major sources of data for them are:

- Task descriptions: Assigned by USACDC representatives based upon the latest series of TOE and a generalized tactical situation.
- Vehicle capabilities data: Assigned by the WHEELS Study Group based upon published technical data and AMC-71 Ground Mobility Model results.
- Cost data: Assigned by the WHEELS Study Group based upon inputs from the Office of the Comptroller of the Army, USATACOM, U.S. Army Field Operating Costs Agency, and the Commercial Vehicle Study. (See Annex D, Volume II.)

- Force structure data: Provided by the Information Data Systems Office, Office of the Assistant Chief of Staff for Force Development (FY 73 Apportionment Force and FY 74 Budget Force).

Computer services and programming support for the model have been furnished by the U.S. Army Management Systems Support Agency.

5.4 FLEET STRUCTURE

(1) The preceding paragraphs have discussed the primary methodologies used in providing WHEELS a capability to analyze vehicles in the broadest sense of a fleet as opposed to the traditional practice of looking at one vehicle at a time. The Phase II time frame (1 April to 1 August 1972) did not allow full exploitation of these capabilities. Although significant achievements have been demonstrated in the quantitative, qualitative, and commercial vehicle areas, much remains to be done. The Study Group believes that further resource savings can be determined through the alternative fleet structuring capabilities now available. Table V-4 illustrates the potential benefits that may result from further comprehensive analyses. This table is a matrix of vehicles by number and percent of fleet within the four major functional categories (i.e., command and control, intelligence, firepower, and logistics) found to the rear of division. Each category, by function, displays the cost of continued use of tactical vehicles, and the costs of acquiring and operating an equivalent number of, first, derated vehicles, and then, commercial vehicles. The three fleets (i.e., tactical, derated, and commercial) are all starting from a common base consisting of the current tactical incumbents, costed on their regular replacement life and a comparable life-cycle span. This illustration serves only to stimulate further analysis. The Study Group would expect examination of the fleet structure to continue throughout Phase III of the study effort and be continued by those concerned with vehicle management.

(2) In spite of the claimed fleet structuring capabilities, the Study Group found one area so fraught with uniqueness that the group could not avoid treatment of it as a separate entity. The 3/4 - 1 1/4-ton truck must be labeled "the Army's supreme enigma in the wheeled vehicle fleet." In every aspect of the WHEELS Study (quantitative, qualitative, commercial vehicles, and management) and indeed in every analysis, the 3/4 - 1 1/4-ton truck asserted itself as a unique problem. On asserting itself, it seemed capriciously capable of becoming the dominant issue. After a careful review of the recent history

of this truck program, the conclusion that it demanded special consideration could not be avoided. A capsule version of this history (admittedly oversimplified) follows.

5.4.1 High-Mobility Concept

(1) The historical objective of the Army to obtain an improved mobility capability over unimproved surfaces received great emphasis during the late 1950's and throughout the 1960's. Over these years, the objective was successively refined until the concept essentially stated a requirement for high-mobility vehicles in units that habitually operate forward of the brigade rear, with all other units requiring only conventional-mobility trucks. During the early years of this period, the 3/4-ton payload requirements were being satisfied by a sole-source procurement of a quasi-commercial item (M37-series).

(2) During the early 1960's, the Army undertook programs responsive to the high-mobility concept.

- The 1 1/4-ton high-mobility XM561 GAMA GOAT underwent development with production scheduled in FY 66. It was to replace all 3/4-ton trucks (ambulances included) in brigade areas and selected units behind the brigade.

- The 1 1/4-ton conventional-mobility XM705 underwent development (total package procurement), with production scheduled in FY 67. It was to replace all 3/4-ton trucks not replaced by the GAMA GOAT.

(3) In 1963-64, the Army, in response to interest expressed by the Congress and the Office of the Secretary of Defense (OSD), agreed to terminate forthwith any further sole-source procurement of the 3/4-ton M37 truck. An almost concurrent decision was made to procure an interim militarized commercial 1 1/4-ton truck (XM715) pending availability of the GAMA GOAT and the XM705.

(4) The GAMA GOAT was type classified Standard A (i.e., ready for production) in 1966, but requests for production funds were denied until 1968 when an Army request for approximately 25,000 vehicles obtained OSD approval to procure about 13,000. The high-mobility requirement for this vehicle was then adjusted to accommodate the number to be available (i.e., only the maneuver elements of

Active Force brigades would receive the GAMA GOAT). Meanwhile, additional XM715 vehicles were procured to offset delays in both the GAMA GOAT and XM705 programs.

(5) In 1969, an improved version of the XM715 was offered as a challenge to the XM705 on the basis that it was adequate and cheaper. This issue was settled in 1971 when the XM705 total package procurement contract was cancelled. The final production deliveries of the XM715 had been made in 1968 and the program terminated. At the end of 1971, the Army had in its inventory three vehicles (M37, M715, and the GAMA GOAT) to satisfy the 3/4 - 1 1/4-ton payload requirements, with no further production contemplated for two (i.e., the M37 and the M715) and deliveries of the GAMA GOAT representing the only incoming assets.

(6) Almost concurrent with the XM705 termination decision, directions were issued to undertake a 1 1/4-ton truck program to obtain a quasi-commercial vehicle (XM852) against a performance specification, with no technical data package and with prototypes available in FY 74. Thus the circle, starting with termination of a quasi-commercial truck (M37), to interim procurement of a quasi-commercial truck (XM715), to development of a military-design truck (XM705), and finally to a quasi-commercial truck (XM852), was completed. The results of these actions were as follows:

- An insufficient number of GAMA GOATS to fill 1 1/4-ton requirements of the high-mobility concept.
- An adjustment of 1 1/4-ton high-mobility requirements to reflect the less than adequate number of GAMA GOATS (i.e., true and approved requirements were not stated in requirements documents). This was an unfortunate move because requirements documents should reflect the true requirements. Shortages and what to do about them, should be a function of the program, budget, and distribution processes.
- A mix of three vehicles to fill conventional-mobility requirements, though none of these are in production.

5.4.1.1 Analysis

(1) The WHEELS qualitative analysis and the Commercial Vehicle Study led to the following conclusions:

- The high-mobility concept was valid for units operating habitually in the brigade area and for selected division units
- A commercial vehicle, procured from existing production lines, could fill 3/4 - 1 1/4-ton requirements for all other units.

(2) In an attempt to eliminate the uniqueness of this payload, and hopefully to stop the circle of "unplanned events" plaguing this payload, WHEELS undertook a review of current Army plans with respect to requirements for the GAMA GOAT. These plans are represented in the document, "Complete Basis of Issue Plan (CBOIP) for Truck Ambulance and Truck Cargo, 1 1/4-ton GAMA GOAT, 23 June 1971," as revised 16 July 1972. This document is considered to be a valid representation of the high-mobility concept in that units requiring high mobility are adequately identified. Further, with application of the quantitative adjustments necessary as a result of the TVRB and WHEELS determinations, the document is consistent with all other findings of the WHEELS Study (in particular, those within the area of qualitative analysis and in the Commercial Vehicle Study).

(3) WHEELS subjected its conclusion, that a commercial vehicle is adequate for all 1 1/4-ton requirements in units not needing the GAMA GOAT, to a sensitivity analysis. The parameters for the analysis were:

- Commercial vehicles are adequate and will be used behind the division rear
- GAMA GOATS are adequate and will be used forward of brigade rear.

These parameters narrow the analysis of the question of vehicle selection for the area between division rear and brigade rear. There are three alternative options for consideration (designated as Options A, B, and C). Option A continues the use of existing 3/4 - 1 1/4-ton trucks from the current fleet, and the maintenance of these models

indefinitely. This has the advantage of sustaining a more-than-reasonable degree of high-mobility vehicles, but guarantees a minimum of three or four vehicle types with which direct and backup maintenance units must contend. Use of derated military vehicles, Option B, reduces cost by approximately $6 million, with a proportionate reduction in both mobility and maintenance. The first two options are characterized by greater mobility, but are plagued with the addition of a third vehicle type in the brigade rear area. The use of commercial vehicles, Option C, promises the least in mobility and provides an extension forward of vehicles already found behind division rear. In reality, this option offers a two vehicle system at the lowest life-cycle costs (i.e., a savings of $19 million over Option A and $13 million over Option B). The real question here becomes one of whether mobility requirements behind brigade rear can be satisfied with an appropriate commercial model at what is obviously the least expensive of the options available. Costwise, it is clear that the commercial option provides the greatest savings, but of much greater importance is that the commercial option eliminates the 3/4 - 1 1/4-ton tactical and derated fleet, and provides a simple two-vehicle (GAMA GOAT and commercial) family.

5.4.2 WHEELS Fleet Structure Information

The posture of the wheeled vehicle fleet has changed (or will soon change) considerably since January 1972 when the FY 73 President's Budget was established. Using vehicle requirements stated in that budget as a base case, these changes are depicted in three illustrations. Figure V-2 provides an illustration of incremental quantitative changes to the wheeled vehicle fleet, and shows a 25-percent reduction in total requirements from the base case. Commercial vehicles within the fleet increase from 20 to 45 percent. Figure V-3 provides an illustration of incremental cost changes of the tactical fleet, and shows a $.282 billion annual savings and a $4.512 billion life-cycle savings. Table V-5 provides information concerning quantitative requirements (IIQ and AAO), average annual fleet costs (investment, operating, and support), and full-time driver costs of the WHEELS recommended "new" tactical wheeled vehicle fleet. The "new fleet structure" reflects the collective effects of changes to logistic factors that result from the TVRB study, approved REVA actions, and WHEELS recommendations contained in this report.

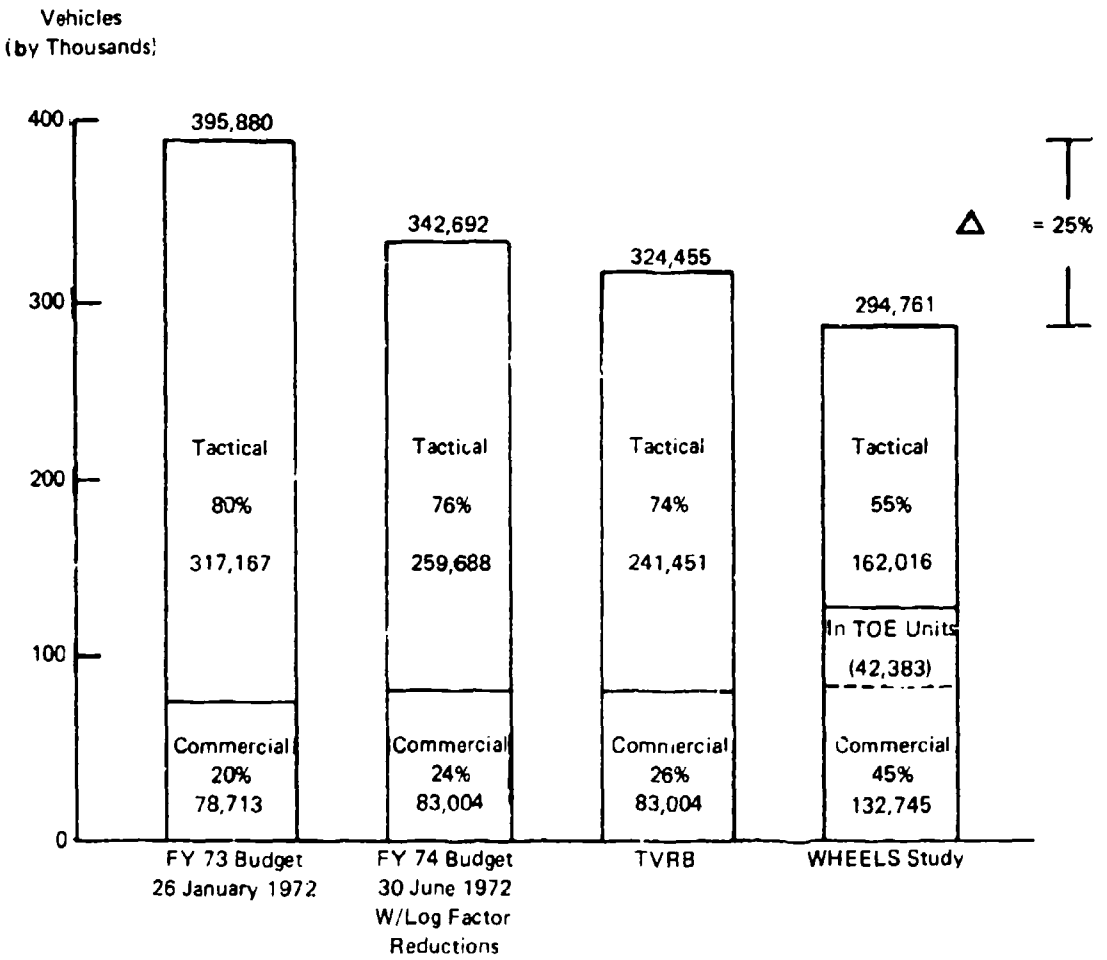
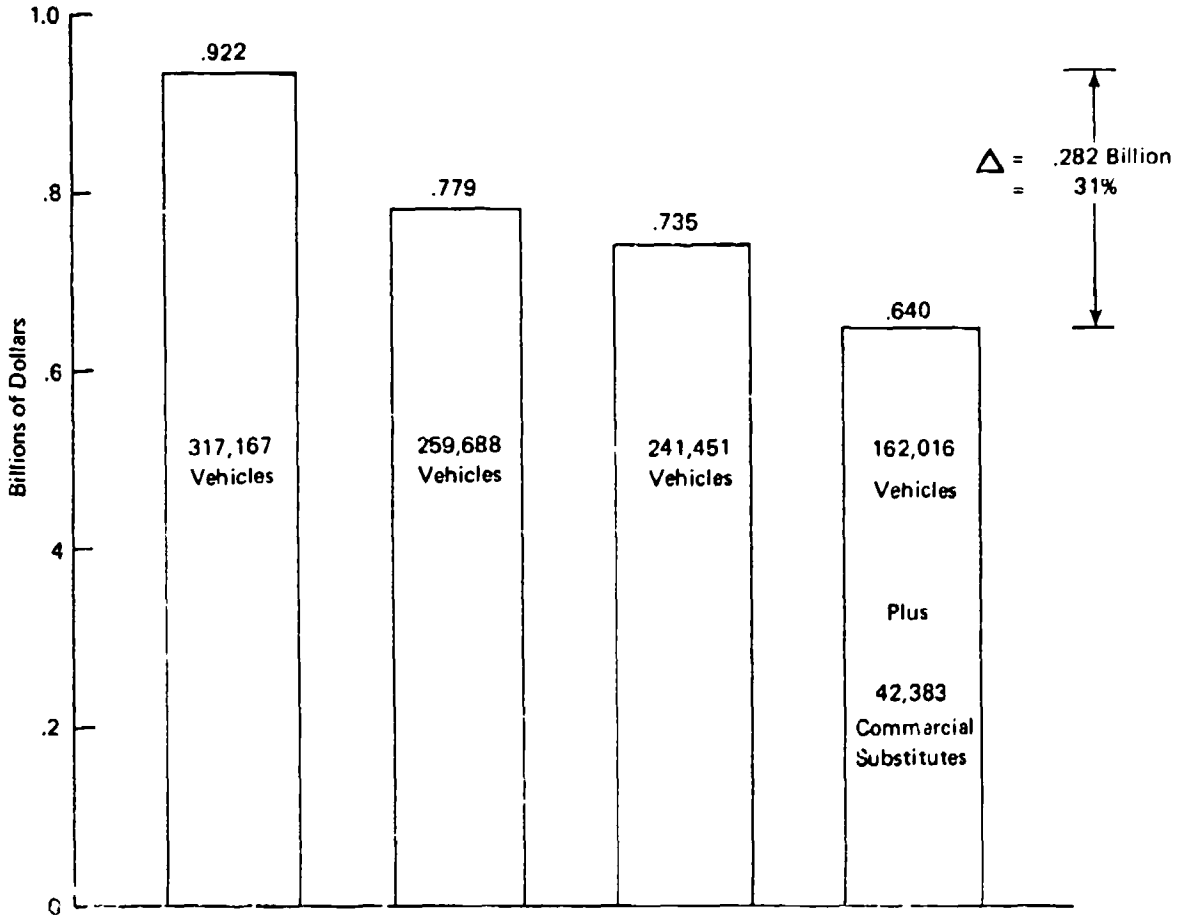


FIGURE V-2. QUANTITATIVE CHANGES TO WHEELED VEHICLE REQUIREMENTS



Cumulative Savings from Base (FY 73 Budget)

Annual Fleet	.143	.187	.282
Annual Full-Time Drivers	.006	.023	.094
12-Year Total Life Cycle	1.788	2.520	4.512

FIGURE V-3. COST CHANGES TO THE TACTICAL WHEELED VEHICLE FLEET

5.4.3 Major Impact Recommendation

Terminate the 1 1/4-ton XM852 program and authorize 1 1/4-ton commercial vehicles for all 1 1/4-ton applications other than those requiring a high-mobility vehicle.

5.4.4 Other Recommendations

(1) Initiate necessary action by ACSFOR to adjust the quantitative aspects of the GAMA GOAT CBOIP to reflect TVRB and WHEELS quantitative reductions, and to incorporate the adjusted CBOIP into appropriate TOE.

(2) Initiate necessary actions by DCSLOG, in coordination with the ACSFOR and DCSOPS, to effect distribution of GAMA GOAT assets in accordance with the CBOIP and in the following general order of priority:

- Units in the Active Forces that habitually operate forward of the brigade rear
- Units in the Active Forces that habitually operate between the division and brigade rear
- Units in the Reserve Force.

CHAPTER VI

FISCAL YEAR 1974 BUDGET AND FISCAL YEARS 1975-1979 PROGRAM OBJECTIVE MEMORANDUM

6.0 GENERAL

(1) One of the principal study objectives of WHEELS, specifically identified as a task during Phase II, is to develop recommendations for input to the Fiscal Year (FY) 1974 Budget and the FY 75-79 Program Objective Memorandum (POM). As discussed in Chapter II, the quantitative content of the fleet has undergone a marked change since January 1972. Additionally, and in accordance with other WHEELS objectives, the fleet qualitative posture is potentially subject to changes as a result of recommendations concerning tactical wheeled vehicle design (see Chapter III) and increases in commercial vehicles (see Chapter IV). These changes raise new, and for tactical vehicle programming, unusual considerations.

(2) Probably not since the end of World War II has the Army been faced with a situation in which existing assets so grossly exceed requirements. However, consideration has to be given to the age and condition of the fleet before arbitrarily zeroing new acquisition programs and budgets with considerations attendant to the question of a "hot" versus "cold" production base. Maintenance programs and policies, some of which may have been established so many years ago that the conditions causing their establishment have been lost in time, must be critically reviewed in light of this new and rather strange situation. Witness, for example, the original concept associated with the introduction of the M151-series 1/4-ton vehicle. This was essentially a "throw-away" concept, but implementation was never really possible because of conditions prevailing at the time. New conditions exist and the concept should be reexamined for possible application. Other policies and procedures may well exist that should be changed in recognition of the "new" wheeled vehicle posture. Consideration should be given to constraining the level of authorized maintenance of selected vehicles as a means of executing a "controlled washout" program. Constraints that would not have been practicable previously may now merit serious consideration.

(3) The fleet analyses that follow represent general considerations. Specific maintenance planning required as a result of the fleet posture is better left to the more qualified expertise available in the responsible Staff activities of Headquarters, Department of the Army (HQ, DA), and subordinate commands.

6.2 Major Impact Recommendation

The reduction of requirements inherent in the entire WHEELS Study must be reflected in programming and budgeting for the FY 74 Budget and the FY75-79 POM.

6.3 Other Recommendations

(1) Have DCSLOG and USAMC, in coordination with the WHEELS Study Group (Phase III), determine the cost effectiveness/savings that can be obtained through standardization within a payload by reducing models (i.e., using excesses as a means of reducing Standard B items).

(2) Have DCSLOG and USAMC, in coordination with the WHEELS Study Group (Phase III), determine the cost effectiveness/savings of substituting, through a time-phased plan, the excess 2 1/2-ton truck for the 3/4 - 1 1/4-ton M37 and M715 as a means of eliminating one payload from the fleet.

CHAPTER VII

MANAGEMENT

7.0 GENERAL

(1) The preceding chapters have addressed those study efforts undertaken with the principal objective of providing a basis for immediate reductions in resource requirements and for impacting these reductions into the program and budget cycles. These efforts—quantitative reductions, elimination of unnecessary and costly design features, and more reliance on commercial vehicles—entailed determinations that could be made only on the basis of availability of an extensive data base of information, including:

- Costs—Acquisition, operating, support, and personnel
- Vehicle Life—Economics of retention, disposal, and overhaul
- Inventory—Assets, age, and distribution
- Mobility—Requirements versus capability
- Constraints—Regulations, statutes, policies, procedures, and processes.

In pursuing the development of this vital information, members of the WHEELS Study Group became impressed with two fundamental and perplexing truths.

- The information necessary to efficiently manage the Army vehicle program does not exist in many areas; in others, it exists only as fragments that require extensive time and research to collect in manageable form.
- Only limited efforts are underway to initiate the necessary actions that will lead to development of information that currently does not exist; and only

an "abstract" acknowledgment has been made that actions are necessary to make existing fragmented information more responsive to management.

(2) With the experiences gained from seeking ways to achieve immediate resource reductions, the WHEELS Study Group undertook an analysis of management. In establishing WHEELS, Chief of Staff Memorandum (CSM) 72-15-28 addressed management in two ways:

- Objective—"Analyze the management process and the organizational structure, particularly at HQ, DA, for management of wheeled vehicles and provide firm recommendations that will aid in resolution of current problems and serve as a basis for improving the management of the Army's wheeled vehicles."

- Area for Analysis—"Adequacy of management of wheeled vehicles in view of PEMA, MPA, and OMA dollars involved. Organizational structure and possible need for more centralization. Need, timeliness, adequacy, and use of information for management of the wheeled vehicle fleet."

7.0.1 Study Approach

The total study approach was divided into three areas:

- Management Processes
- Management Organization
- Management Information Systems

As the three efforts progressed, findings of a general nature asserted themselves.

- Processes—Some are adequate as they currently exist, but others are not. Some can be improved immediately, whereas others will require extensive analysis beyond the time frame of Phase II. Collectively, the processes do not provide a cohesive, integrated program that can serve as a mechanism for efficiently managing a system with the scope and complexity of the vehicle fleet.

- Organization—Structural changes at Headquarters, Department of the Army (HQ, DA), are required if the wheeled vehicle fleet is to be managed as a system, and if that management is to ensure a fleet responsive to the operational and support requirements of the Army while keeping resource requirements to minimum essential levels.

- Management Information System—The profound scope of information required for efficient management of the fleet demands development of a disciplined vehicle management information system.

7.0.2 General Conclusions

(1) Development of totally integrated management processes, a responsive management information system, and a proper organizational structure to manage those processes and draw from the system requires a period of further intensive management analysis.

(2) Perceived organizational changes should not be implemented pending completion of the analysis and availability of the resulting "management mechanisms."

(3) Phase III of WHEELS provides for personnel and time to conduct the necessary management analyses and, while so engaged, provides the Army with an interim organizational structure at HQ, DA, sufficient to achieve intensive management requirements under the guidance and direction of the WHEELS Steering Group. At the completion of Phase III of WHEELS, that interim organization, with its developed management mechanisms, should provide the cadre for achieving the required organizational changes within the DA Staff.

7.1 MANAGEMENT PROCESSES

The management processes examined in this section fall within the following areas:

- Qualitative
- Quantitative
- Development, Test, and Evaluation

- Logistic Support
- Cost.

7.1.1 Qualitative Management Processes

(1) The processes by which management can influence and control the qualitative aspects of wheeled vehicles (existing inventory and conceptual inventory) can be analyzed in the context of the methods by which the Army generates operational requirements for wheeled vehicles. A significant element of generating requirements is the qualitative determination, and a prerequisite to this is a clear understanding of what the item must do. As discussed in Chapter III, the wheeled vehicle fleet should be structured into three levels of mobility capability if the Army is to obtain resource efficiencies (i.e., minimum essential quality for each mobility level). This structuring adds more emphasis to the processes by which the Army manages the qualitative aspects of vehicles.

(2) These processes are emphasized in procedures for developing requirements documents (i.e., the Qualitative Materiel Requirements (QMR) and the more recent Materiel Need (MN) process, which is now being replaced by the Required Operational Capability (ROC) system). The Study Group's analysis shows that these describe, in excessive detail, the physical features of a tactical vehicle, and inadequately describe the mission profile. This has restricted design of trucks to the point that all must satisfy the most stringent operational conditions, although a significant portion of the fleet will never be subjected to the rigorous conditions found in the ground-gaining environment. Full evaluation of this problem is difficult, because no tactical truck has been developed or produced under the current MN process to allow a detailed comparison of results. The recently proposed MN document for the 1 1/4-ton XM852 truck (which is to replace the 3/4-ton M37 and 1 1/4-ton M715 trucks) does, however, contain these same restrictive design descriptors, which would lead to vehicles adequate for the most difficult conditions but with expensive features unnecessary for operations in many areas.

(3) The discussion and series of tables that follow provide data from the WHEELS Fleet Model and allow analysis of requirements for tactical vehicles by examining where they are used, what they do, and what degree of mobility is required. The initial effort is a review of the broad fleet application and will be refined during Phase III of the study to isolate elements of the fleet that require restructuring during later procurement.

7.1.1.1 Analysis of Vehicle Fleet Application and Requirements

(1) As can readily be seen by examining Tables VII-1 to VII-6, there is a decided need for a clearer description of the mission profile associated with a tactical vehicle. These tables clearly indicate the strong interrelationship between the functions area and mobility in determining qualitative requirements. These relationships must be included in the description of a vehicle's mission profile to adequately explain the need and to provide the necessary management decision information. The data used from the WHEELS Fleet Model were produced by reviewing each Table of Organization and Equipment (TOE), each vehicle required by that TOE, and the function performed by each vehicle in its assigned role.

(2) The tables illustrate that:

- The concept of providing three levels of mobility to the tactical wheeled vehicle fleet is substantiated by evaluation of tasks and area data.
- Sufficient requirements exist for support-mobility vehicles to warrant redesign and procurement of the less-expensive derated model.
- Approximately one-fourth of all tactical wheeled vehicles will perform functions in the brigade area and should be provided high-mobility capability.

(3) As indicated in Table VII-1, almost 31 percent of all tactical wheeled vehicles perform tasks identified with command and control; whereas more than 58 percent accomplish required logistic operations. As can be expected, most of the vehicles associated with command and control are 1/4- and 1 1/4-ton; whereas most trucks used for logistics are 2 1/2-ton or larger. A comparatively small number of vehicles are assigned intelligence and firepower functions.

(4) Table VII-2 reflects the application of the major payloads within selected areas of the theater. Although many of these vehicles cross these area boundaries in fulfilling their missions, the unit to which they are assigned is usually located within the general area shown. As indicated, more than 26 percent of all tactical vehicles perform functions within the brigade area of operations, and approximately 61 percent perform tasks primarily behind the division rear boundary. However, to the rear of division, the 2 1/2-ton and larger trucks are used

TABLE VII-1
DISTRIBUTION OF TACTICAL VEHICLES BY WEIGHT CLASS AND FUNCTION WITHIN THE THEATER OF OPERATIONS[1]

Payload	Function				Total
	Command and Control	Intelligence	Firepower	Logistics	
1/4-ton	19%	2%	3%	3%	27%
1 1/4-ton	7%	Less than 1%	3%	9%	19%
2 1/2-ton	4%	Less than 1%	2%	25%	31%
5-ton	Less than 1%	Less than 1%	Less than 1%	17%	19%
More than 5-ton	Less than 1%	0	0	4%	4%
Total	31%	3%	8%	58%	100%

[1] Entries represent percentages of the total tactical wheeled vehicle fleet.

TABLE VII-2
DISTRIBUTION OF TACTICAL VEHICLES BY WEIGHT CLASS AND AREA WITHIN THE THEATER OF OPERATIONS[1, 2]

Payload	Area			Total
	Brigade	Division	Rear of Division	
1/4-ton	10%	4%	13%	27%
1 1/4-ton	6%	3%	11%	20%
2 1/2-ton	7%	4%	20%	31%
5-ton	3%	2%	13%	18%
More than 5-ton	Less than 1%	Less than 1%	4%	4%
Total	26%	13%	61%	100%

[1] Entries represent percentages of the total tactical vehicle fleet.

[2] One percent deviation from previous mobility totals caused by rounding percentages in this breakout.

TABLE VII-3
DISTRIBUTION OF TACTICAL VEHICLES BY FUNCTION WITHIN AREAS OF THE THEATER OF OPERATIONS[1]

Function	Area			Total
	Brigade	Division	Rear of Division	
Command and Control	8%	5%	18%	31%
Intelligence	Less than 1%	Less than 1%	2%	3%
Firepower	4%	1%	3%	8%
Logistics	13%	7%	38%	58%
Total	26%	13%	61%	100%

[1]Entries represent percentages of the total tactical vehicle fleet.

TABLE VII-4
DISTRIBUTION OF TACTICAL VEHICLES BY MOBILITY CLASS REQUIRED BY AREAS IN THE THEATER OF OPERATIONS[1]

Area	Mobility			Total
	High	Standard	Support	
Brigade	15%	8%	3%	26%
Division	1%	6%	6%	13%
Rear of Division	1%	26%	34%	61%
Total	17%	40%	43%	100%

[1]Entries represent percentages of the total tactical vehicle fleet.

TABLE VII-5
DISTRIBUTION OF TACTICAL VEHICLES BY FUNCTION AND MOBILITY CLASS REQUIRED WITHIN THE THEATER OF OPERATIONS[1]

Mobility	Function				Total
	Command and Control	Intelligence	Firepower	Logistics	
High	8%	Less than 1%	3%	6%	18%
Standard[2]	11%	2%	4%	23%	40%
Support[2]	12%	Less than 1%	1%	29%	42%
Total	31%	3%	8%	58%	100%

[1]Entries represent percentages of the total tactical vehicle fleet.

[2]One percent deviation from previous mobility totals caused by rounding percentages in this breakout.

TABLE VII-6
DISTRIBUTION OF TACTICAL VEHICLES BY MOBILITY CLASS AND MAJOR PAYLOAD REQUIRED IN THE THEATER OF OPERATIONS[1]

Payload	Mobility			Total
	High	Standard	Support	
1/4-ton	31%	34%	35%	100%
1 1/4-ton	20%	46%	34%	100%
2 1/2-ton	12%	32%	56%	100%
5-ton	6%[2]	46%[2]	48%	100%
More than 5-ton	Less than 1%[2]	87%	13%	100%
Total	N/A	N/A	N/A	100%

[1]Entries represent percentages of each weight class.

[2]Application of GOER BOIP will shift selected 5-ton high- and standard-mobility requirements to the more than 5-ton category.

in much greater numbers than the lighter vehicles, reflecting the heavier tasks of distribution in the combat service support organization.

(5) Table VII-3 illustrates the relationship of the percentage of vehicles performing the major functions within selected areas. The brigade area utilizes approximately as many vehicles in the three functions of command and control, intelligence, and firepower as are used in the one function of logistics. The same proportion exists in the division area. Conversely, considerably more vehicles (almost 2 to 1) fill the logistic role to the rear of division than are filling the combined three functions of command and control, intelligence, and firepower.

(6) Table VII-4 illustrates the degree of mobility required within the various areas of the theater. The percentage of support-mobility vehicles indicated theaterwide (almost 43 percent) appears at variance with the proposed procurement of only 29 percent contained in Chapter III, Section 3.3. This variance, however, is valid in that only those units operating behind division would actually be issued derated (support-mobility) trucks. This is done to maintain the distribution of all vehicles forward of the division rear boundary in a high- or standard-mobility class where substitution of one for the other would not seriously degrade mobility capability for operating cross-country. As shown, the larger number of high-mobility vehicles are required in the brigade area, with only a small number of selected tasks requiring such a mobility capability behind that area. The decision also is limited by procurement of such vehicles for only the four major payloads. This explains the difference between the almost 34-percent support-mobility vehicles required behind the division and the 29 percent recommended for procurement.

(7) Table VII-5 illustrates mobility requirements by function to be performed. The bulk of all high-mobility tasks are split between command and control and logistics. The preponderance of tasks requires only standard- or support-mobility vehicles. Small numbers of vehicles perform intelligence and firepower missions, but more than two-thirds of the remaining vehicles are engaged in logistic activities whereas the others are used for command and control.

(8) One further comparison was made to identify mobility requirements within each payload. In Table VII-6, the distribution of vehicles is shown for each mobility class within each payload. One irregularity in the table requires explanation to preclude misunderstanding. The 1 1/4-ton payload reflects current restrictions that

apply high-mobility models to only selected Active Forces forward of the brigade rear boundary. The WHEELS Study has recommended broader application policies in line with the Complete Basis of Issue Plan (CBOIP) for the high-mobility 1 1/4-ton, issuing it to all units in the brigade area, both Active Army and Reserve as well as to other selected Active units in the division area. (See Chapter V.) This is now possible because of quantitative reductions for vehicles throughout the Army. The high-mobility requirements for the 1 1/4-ton will be increased to approximately 30 percent of the requirements for that weight class as a result of full application of the CBOIP and conversion of most 1/4-ton ambulance requirements to 1 1/4-ton.

(9) Other management information considerations revealed some areas requiring further detailed analysis during Phase III of the study effort.

- The 1/4-ton fleet requirements are divided about equally among the three mobility classes. However, the present M151A2 has restrictions in rough terrain and soft soil operations. These make it a marginal performer in the high-mobility roles when compared with other high-mobility vehicles, as confirmed in performance predictions of the AMC-71 Ground Mobility Model.

- The 2 1/2-ton fleet has a relatively small requirement for high-mobility trucks (approximately 12 percent), but there is no vehicle in this class that performs with the same degree of cross-country capability as those designed specifically for such missions (the 1 1/4-ton GAMA GOAT, the 5-ton M656, and the 8-ton GOER).

- The trucks in the 5-ton-and-over weight class have candidates for the high-mobility role in the M656 and the GOER, but quantities on-hand and programmed for procurement currently restrict application outside selected Active units.

- The high-mobility concept is fully supported when considering the mobility needs as identified in the WHEELS Fleet Model. The AMC-71 Ground Mobility Model discriminates between the abilities of the three high-mobility

vehicles (GAMA GOAT, M656, and GOER) and the standard- and support-mobility models to adequately operate in the stringent forward area environment.

(10) An operational test of the high-mobility concept, programmed for FY 74, will compare the capabilities of a unit using conventional vehicles during one phase of an exercise against the unit's capabilities using available high-mobility trucks during a repetition of the same exercise. Preparatory to this test, Phase III of the WHEELS Study should address the integration of the WHEELS mobility requirements data, the AMC-71 mobility capability information, and the draft of the U.S. Army Combat Developments Command (USACDC) high-mobility test plan. Such an effort should identify specific vehicle mixes for use in the test to permit a full application of the advantages of the rough terrain vehicles and the use of test results to confirm the performance predictions of the AMC-71 Ground Mobility Model. The results of the test could then be used in conjunction with the WHEELS Fleet Model to refine the total fleet mix for vehicles to satisfy the various mobility requirements.

7.1.1.2 Qualitative Aspects of Drivers

(1) The personnel functioning in the vehicle area must also be considered with any discussion of qualitative vehicle requirements. Based on review, analysis, and comparison of Army drivers and wheeled vehicle mechanics with their commercial counterparts, certain changes are required in Army selection and training procedures. The requirements for these changes are brought about by a critical comparison of the types of people involved in driving and maintaining wheeled vehicles for the Army (generally E-4's, 22-24 years old, having Armed Forces Qualification Test (AFQT) scores of 41 and 44, which are well below the Army average of 50 (see Figure VII-1), and those earning a living as drivers and mechanics for commercial firms. From these comparisons, it becomes evident that at least four major areas in the Army driver/mechanic personnel area deserve special attention.

- Assigned drivers in TOE
- Career patterns
- Skill awards
- Practical proficiency testing.

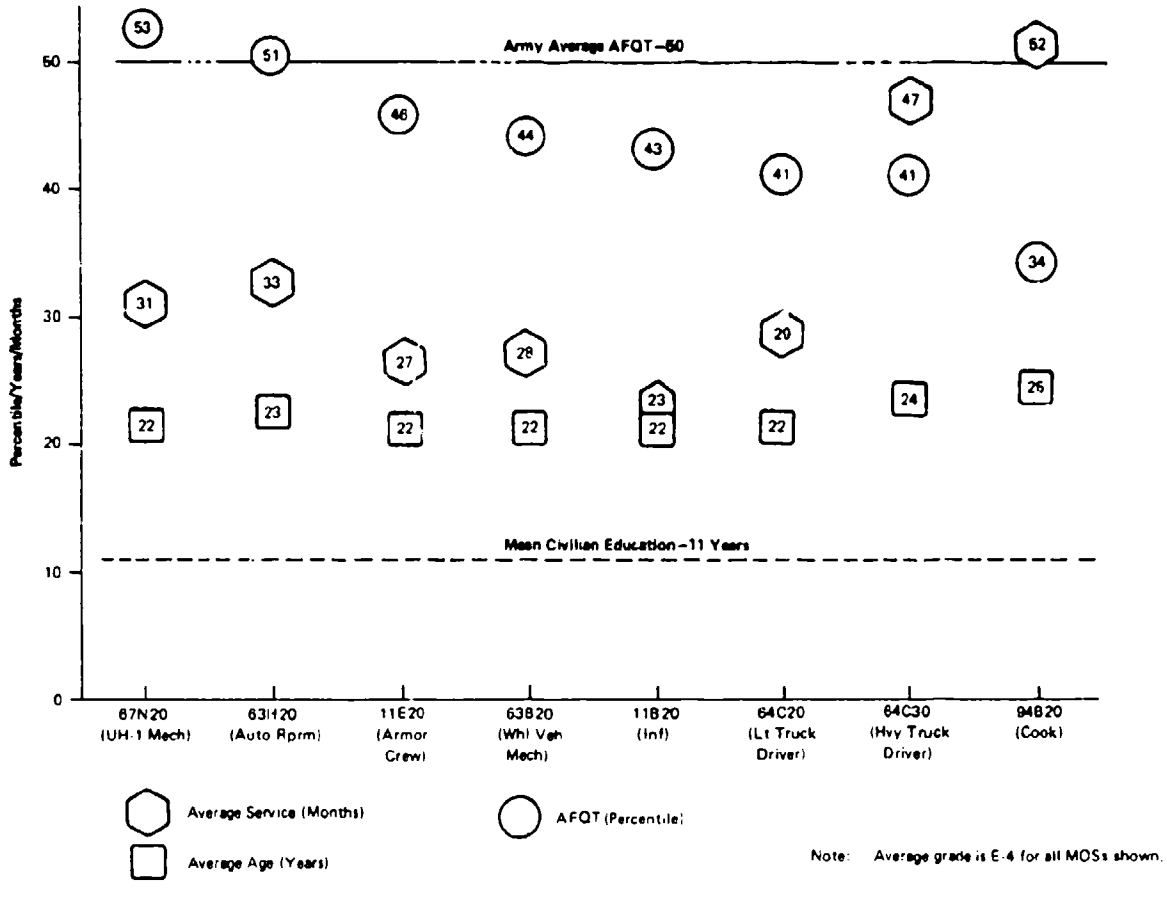


FIGURE VII-1. MOS COMPARISON BY AVERAGE AGE, SERVICE, AND AFQT SCORE

(2) Illustrated in Figure VII-2 is a sampling of selected TOE authorized vehicles versus the number of TOE drivers for those vehicles. The most numerous vehicles, the 1/4-ton utility and the 2 1/2-ton cargo, have only small percentages of assigned drivers (27 percent and 11 percent, respectively). Specialized vehicles such as the 5-ton dump truck and the 5-ton tractor have percentages of TOE assigned drivers that approach or exceed TOE vehicle authorizations (98 percent and 132 percent, respectively). Transportation truck companies are the exception, owing to their being authorized an overage of drivers because of mission requirements. However, only 33 percent of all TOE vehicles have TOE-assigned drivers. Only a handful of advanced individual training programs include driver training. With the vast majority of driver selection and training left to the discretion of an operational unit, numerous unit requirements for personnel time will usually not be subordinated to the need for driver training. To remedy this problem, a more stringent driver licensing and training program should be instituted.

(3) Career patterns for drivers and mechanics within the trucking industry have long been recognized and established as the method for maintaining a high level of experience. Most civilian drivers and mechanics will work at their respective jobs until retirement. As indicated in Figure VII-3, the average civilian driver is 14 years older than his counterpart Army heavy truck driver, and the average civilian wheeled vehicle mechanic is 10 years older than his Army counterpart. The "up-or-out" policy does not allow those Army drivers and mechanics whose abilities lie in truck-handling or physical maintenance, rather than in supervisory roles, to stay for a full military career. This problem could be eliminated and a greater experience level realized by developing strict driver and mechanic career fields patterned after the commercial trucking industry.

(4) In conjunction with driver and mechanic career patterns, senior and master skill awards should be developed. Currently, skill awards such as those for air crewmen, parachutists, and divers are separated into three categories—basic, senior, and master. The Drivers and Mechanics Badge designates only the basic skill (i.e., driver or mechanic, with bars to indicate the type of equipment operated or maintained). Development and implementation of senior and master awards would act as an impetus toward developing and maintaining professional attitudes and esprit.

(5) The commercial trucking industry relies heavily upon driver skill and proficiency. It is to this end that the truck "roadeo" has

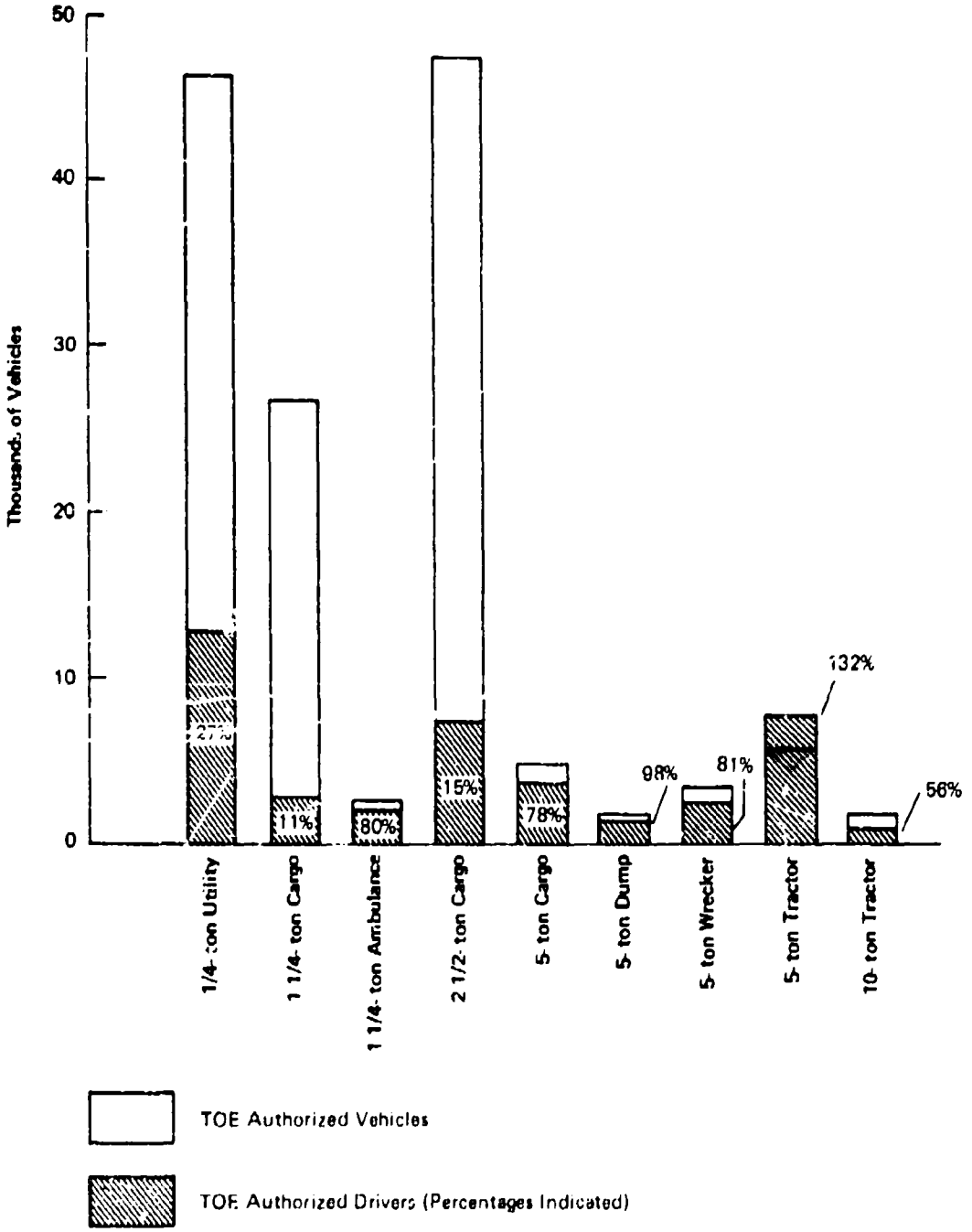


FIGURE VII-2. SELECTED VEHICLES BY BODY TYPE AND TOE AUTHORIZED DRIVERS

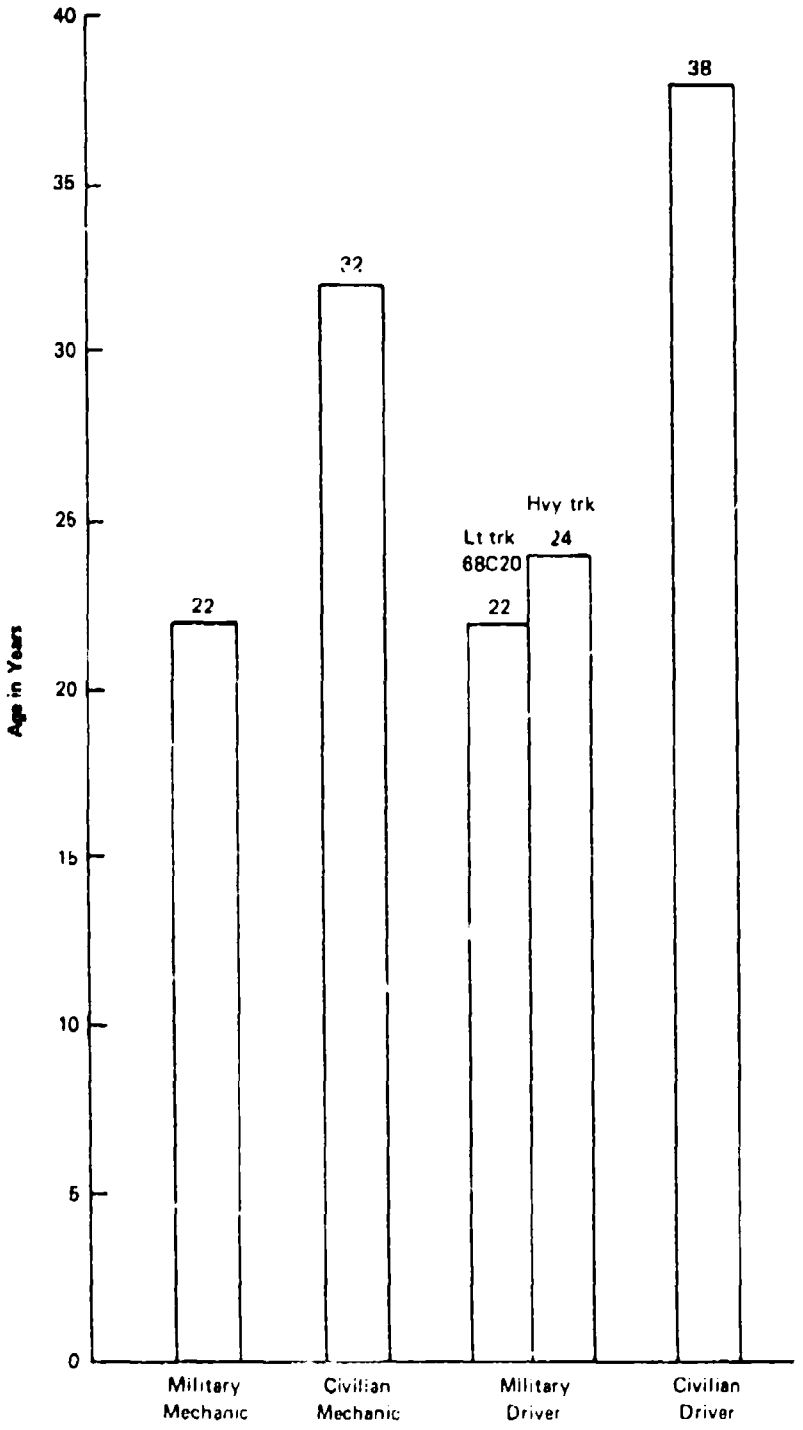


FIGURE VII-3. COMPARISON OF THE AGES OF MILITARY AND CIVILIAN MECHANICS AND DRIVERS

been developed. Essentially a competitive event, the roadeo also serves as an inexpensive training and testing device by which a company can test seasoned drivers' experience. With equipment and cargo at times valued in excess of $100,000, companies recognize the need to ensure driver proficiency. The Army currently has no formalized, mandatory driver proficiency test; however, this could readily be instituted by expanding the Motor Transport Operations' military occupational specialty (MOS) test to include a practical application portion patterned after the roadeo.

7.1.1.3 Recommendations

(1) Apply all available management information of the WHEELS Fleet Model and AMC-71 Ground Mobility Model in writing requirements documents (ROCs) for tactical vehicles to produce mission profiles that adequately describe the intended mission(s) and area of operations and allow for tradeoffs in design as opposed to mandatory single-value characteristics.

(2) Review the high-mobility test scheduled for early FY 74 for proper vehicle mix in consonance with WHEELS Study reductions and monitor the results to confirm performance predictions of the AMC-71 Ground Mobility Model.

7.1.2 Quantitative Management Processes

The process by which quantitative requirements for trucks are generated may well be considered one of the more important aspects of wheeled vehicle management. These processes are initiated at the same time a requirements document is developed, and culminate in quantities identified as Authorized Acquisition Objectives (AAOs), which serve as the basis for programs and budgets. Thus, management of quantitative requirements begins early in the life cycle and continues throughout that cycle. The following are the primary processes for governing quantitative requirements:

- Basis of Issue Plans (BOIP)
- Table(s) of Organization and Equipment (TOE)
- Table(s) of Distribution and Allowances (TDA)

7.1.2.1 Basis of Issue Plans

(1) The BOIP is the means for initially expressing requirements for new items not yet stated in TOE, TDA, Joint Tables of Allowance (JTA), Common Tables of Allowances (CTA), and Operational Projects. USACDC is the major proponent of the BOIP. A BOIP is prepared for each new item of equipment concurrent with development of a requirements document, and is subjected to continuing refinement during research and development of the item. It includes requirements for associated items as well as new or additional personnel to support the system and equipment. Automated systems have been or are being developed to facilitate incorporation of finalized information from the CBOIP into appropriate TOE and/or modified TOE (MTOE) authorizations of The Army Authorization Document System (TAADS). In TOE, the BOIP addresses only Level 1, which is the "full TOE" or 100 percent requirement for personnel and equipment that should accompany a unit when deployed or committed to sustained combat. The BOIP is a requirements document; it is not an authorization document.

(2) The BOIP is also used as an analysis document to evaluate the impact of a new item of equipment on the Army force structure, to compute Army materiel requirements for programming, and to provide a source of information for distribution to include related support actions. OACSFOR applies the BOIP to the Structure and Composition System (SACS) file in the determination of the initial issue quantity (IIQ). In turn, the IIQ is provided to the Deputy Chief of Staff for Logistics (DCSLOG) for the computation of the AAO.

(3) The standard requirement codes (SRCs) used in the BOIP normally do not represent current TOE of the series used in the SACS file, but those of earlier series. This, for example, requires the use of an extrapolation program to convert pre-"G" and "H"-series TOE to the G and H-series SRC. The possibility of error in this procedure is recognized; however, the error is smaller than it would otherwise be if non-G or H-series data were applied.

(4) The process of updating BOIP, to include SRCs and the effective date, is not timely. Both items are important in the determination of IIQ for the Program Objective Memorandum (POM) and the Budget and Apportionment Forces, not only for the year being considered but also for the "out-years."

(5) Associated items for various equipment are frequently major end items. For example, a BOIP for a water purification set

may list such associated items as a 2 1/2-ton truck, with a trailer and/or a 5-kw generator. In the staffing process, it is most probable that the associated items, even though they are major end items, do not receive the same degree of scrutiny as the principal item.

(6) It has been observed that, on occasion, the same personnel and equipment have been deleted and traded-off in different BOIP. Improvements are required to eliminate or at least minimize this "double-dipping."

(7) In the preparation of the BOIP, consideration is not always given by the proponent to the inclusion of direct support/general support (DS/GS) maintenance unit personnel and equipment that are essential to support the new equipment being fielded (i.e., the BOIP fails to reflect total impact).

(8) Current BOIP procedures provide for identification of skills (MOS) and the number of personnel in those skills (see DA Form 3362a, BOIP—Continuation Sheet). This section of the BOIP (i.e., Personnel Changes) should be revised to require identification of grade, MOS, branch, additional skill identifier, and number. This expanded personnel information is necessary for management considerations in the areas of personnel and training. In addition, such information will facilitate later preparation of the Qualitative, Quantitative Personnel Requirements Information (QQPRI).

(9) In those BOIP where significant personnel impacts occur, specifically in those cases requiring increases in personnel, major commanders should be given the option of declining the item(s) of equipment because of the enforcement of rigid space ceilings. If it is not permissible to decline issue, perhaps because of support requirements associated with contingency plans, then possible placement of the equipment in depot-like storage should be considered.

(10) Accuracy and timely preparation and submission of BOIP is inhibited owing to the limited number of personnel available for BOIP processing in the U.S. Army Combat Developments Command (USACDC).

(11) USACDC has developed a three-phased system to automate the BOIP, which is briefly explained on the following page.

- Phase I—Development of all programs, procedures, and instructions necessary to implement an automated BOIP system. Target completion date: 1 September 1972

- Phase II—Development of all programs, procedures, and instructions necessary to transmit an error-free BOIP and the entire BOIP file to DA, as requested. Target completion date: 1 December 1972

- Phase III—Presently in the planning stage; will include all programs and procedures necessary to interface the TOE and BOIP systems.

7.1.2.2 Table(s) of Organization and Equipment

(1) The TOE are designed to identify personnel and equipment to meet worldwide wartime mission requirements of a specific unit. The final DA-approved TOE is a requirements document used as one basis to calculate amounts of personnel and equipment required to man and equip the Army in-the-field, and to plan for future configurations based on projected force structures.

(2) AR 310-31, as supplemented by USACDC directives, provides the basic management documents used in TOE development. These regulations appear adequate in providing guidance to control the flow, functional development, and distribution of TOE. However, close examination reveals inherent weaknesses in the overall management program.

(3) The TOE are developed and reviewed through the USACDC chain with little regard to the overall cost impact on the resources available to implement the final document. This is caused by the lack of accurate equipment cost data and force structure information (i.e., the primary source of cost data for use by TOE proponents is SB 700-20 which contains prices that are often distorted to the point that the document provides only a general guide). This lack of correct information leaves TOE developers without the information or basis to produce a realistic cost analysis. Availability of accurate cost data and force structure information at all levels in the TOE development chain would materially improve the management aspects by allowing the TOE developer to accurately estimate the impact of additions and deletions to a given TOE. In addition, the requirement that the TOE developer provide a detailed costing of personnel and equipment for each TOE

submitted to DA would provide a useful management indicator for the DA Staff to use in the approval process. A listing of desirable management indicators to be provided to USACDC and HQ, DA, for use in the TOE development process is provided in Annex G, Volume II.

(4) Significant management improvement will result from the recommended changes to AR 310-34, "Equipment Authorization Policies and Criteria," contained in Annex B, Volume II. (Also see Recommendations, Chapter II, this volume.) This summary of rules, translated into authorization criteria and based on approved Recommended Vehicle Adjustment (REVA) actions, will provide definitive guidance to the TOE proponent on the types and quantities of vehicles to be authorized in TOE. The proliferation of vehicles found in current TOE can be attributed to the lack of guidance and control provided by the current edition of AR 310-34. The subjective judgment of the TOE proponent provided the basis for the great percentage of vehicles currently authorized. The recommended changes to AR 310-34 will greatly reduce judgment as the basis for authorization, and if strictly monitored by TOE approving authorities, will constrain quantities of vehicles authorized by TOE and TDA.

7.1.2.3 Tables of Distribution and Allowances

(1) The management program for vehicles in TDA is sound and progressive. Supervision is exercised within the Office of the Assistant Chief of Staff for Force Development (OACSFOR) for DA, where automated assistance provides ready reference and up-to-date information through TAADS and related systems. Positive influence is exerted through the DA Equipment Survey Program, which gives DA a positive and personal method for reviewing command and installation survey teams in their routine contact with TDA elements.

(2) Changes programmed for AR 310-34 and CTA will further strengthen the DA management position, as will application of REVA 13 (TDA Vehicles) developed by the WHEELS Study Group. The REVA restricts inclusion of tactical vehicles in TDA and specifies a list of exceptions that must be approved by equipment survey teams and, in some cases, by DA. At the same time, the WHEELS Study Group is working to make procurement of commercial vehicles easier and to accelerate the substitution of commercial for tactical wheeled vehicles. Concurrent with these actions, OACSFOR has hosted two worldwide conferences that have emphasized elimination of tactical wheeled vehicles and their replacement with commercial vehicles on a ratio of less than 1 for 1. The TDA vehicle program has shown steady improvement over the last

3 years and should make a significant advance in effectiveness as these actions are brought to fruition.

7.1.2.4 Major Policy Recommendation

Proposed quantitative increases in wheeled vehicle requirements (BOI, TOE, MTOE, TDA, or force structure) will be subjected to an analysis that demonstrates the total resource impact on the Army in terms of dollars, units, personnel, and operating expenses.

7.1.2.5 Recommendations

(1) Relating to "Basis of Issue Plans":

(1.1) Intensify ACSFOR and USACDC efforts now underway to complete development of an automated BOIP system.

(1.2) Intensify ACSFOR actions necessary to ensure currency of Standard Requirements Codes (SRCs) used in BOIP.

(1.3) Initiate ACSFOR action to change DA Form 3362a, "BOIP-Continuation Sheet" to provide for identification of grade, MOS, branch, additional skill identifier, and number of personnel required.

(2) Relating to "Table(s) of Organization and Equipment":

(2.1) Have HQ, DA, provide accurate cost data and force structure information to TOE proponents and require USACDC to furnish a cost analysis of each TOE developed, revised, or changed.

(2.2) Use the management indicators proposed in Annex G, Volume III, as appropriate, during force structure considerations.

7.1.3 Development, Test, and Evaluation

(1) Army development, test, and evaluation (DTE) policies and procedures have been reviewed and analyzed to effect an improvement in their contribution to vehicle management processes. The WHEELS Study Group focused on selected areas of DTE—those areas determined by guidance furnished to WHEELS and additional areas of analysis that surfaced as significant during study efforts.

(2) The analysis was based on the following sources of information:

- Review of Army Staff and command regulations and procedures documents
- Review of planning, specification, and decision documents from specific truck programs
- Visits and discussions with Army and private industry personnel
- Review of articles in general literature
- Specific inputs from Army agencies and commands.

(3) Prime concerns addressed were the effectiveness of:

- Development programs in providing vehicles to meet needs peculiar to the Army
- Army test and evaluation programs in support of vehicle management decisions
- Army reliability, availability, maintainability, and durability (RAM-D) programs in support of vehicle management.

(4) Private industry testing was examined to determine:

- The procedure industry uses to gain confidence in the acceptability of commercial vehicles
- The degree to which it could serve as a basis for Army evaluation
- The possible techniques that could be adopted in Army testing to gain time and resource efficiencies.

7.1.3.1 Review of DTE Policies and Procedures

7.1.3.1.1 Research and Development

(1) Vehicle developments, like other developments, are conducted under the staff supervision of the Chief of Research and Development in response to approved requirements documents. Tactical vehicle development consists mainly of assembly and system

integration of available components (with some modification), and exhaustive testing. Relatively few vehicle components are specifically developed for the Army because the time frame does not allow for time-consuming development of components. Components are developed through exploratory and advanced development efforts in anticipation of future vehicle development needs. The Study Group concluded that support being given to vehicle and componentry development was generally adequate. An investigation that is underway may indicate a need for additional research in exhaust emission controls and fuel conservation (see 7.1.4.14).

(2) Substantial improvement in the contribution of vehicle DTE to Army needs depends primarily on improved determination of the capability needed and improved procurement procedures. AR 1000-1, "Basic Policies for Systems Acquisition by the Department of the Army," which was recently promulgated, profoundly affects the DTE of vehicles. It offers substantial improvements in these two areas, so that the contribution of vehicle DTE should be substantially increased. The new policies appear to be ensured of rapid implementation. A letter of instruction (LOI), which contains detailed guidance with respect to AR 1000-1, is under preparation.

(3) The Study Group found that there was inadequate feedback from the field of actual performance and cost data on existing vehicles. This problem is discussed further under 7.1.3.6. The lack of such data prevents the preparation of accurate estimates of life-cycle costs and effectiveness, which seriously inhibits overall management of vehicles. It is difficult to determine where best to put development resources or even whether new development is the best approach to meeting a given capability need. An excellent opportunity to obtain feedback data on commercial vehicles in TOE units will be present if the decision (now under consideration) is made to deploy commercial vehicles to Europe for administrative tasks.

7.1.3.1.2 Test and Evaluation

(1) Tests conducted on Army materiel intended for type classification consist of two main types: development tests (DT) conducted by the developer and operational tests (OT) conducted by user troops. The dominant forces in the test and evaluation field in recent years have been user involvement and increased operational testing early in the acquisition phase. Starting in late 1970, the Office of the Secretary of Defense (OSD) provided specific guidance on operational test and evaluation, with emphasis on accomplishment by an agency separate

and distinct from the developer. Since then, congressional legislation, additional OSD guidance, and new DA policy have been promulgated with considerable emphasis on user evaluation prior to the first major production decision to determine operational effectiveness and suitability (including reliability, logistics, and training).

(2) The Study Group reviewed the United States Army Test and Evaluation Command (USATECOM) test procedures that apply to wheeled vehicles. These were found to be generally adequate for their purpose. The durability test procedures should be modified to include separate procedures for high-mobility and conventional-mobility tactical vehicles. At present, there is only a single category of tactical vehicles.

7.1.3.2 Relationship of Testing and Management Decisions

Vehicle management is currently placing great emphasis on Army testing during development and acceptance processes. Testing is expected to provide the information on vehicle characteristics and capabilities needed by management for decision and planning purposes.

7.1.3.2.1 Decision Documents and Test Results

(1) Eleven DA vehicle type-classification actions in the 1963-70 time period, and corresponding USATECOM position papers, were examined to help assess the impact of testing on the decisions made. The results of this review may be summarized as follows:

- USATECOM concluded that three of the vehicles were suitable for Army use and these were type classified Standard A (Std-A).
- The 2 1/2-ton 8 x 8 XM410E truck development was terminated, owing in part to poor durability during engineering test and service test (ET/ST).
- Type classification of the XM746 truck tractor was deferred because of poor durability and reliability during ET/ST.
- The 5-ton M54A2 truck (with LDS 465 engine) was type classified Std-A, although no substantial test data were available. (Tests were not completed

until 8 months later.) Substantial difficulties were encountered in the field with the M54A2.

- The other five vehicles were declared by USATECOM to be suitable, provided certain deficiencies were corrected and were type classified Std-A.

- USATECOM noted that the general design concept was acceptable in all but two cases, the XM410E1 and M54A2.

- Final test agency reports were not available in any of these cases for review by in-process review (IPR) voting members, their staff, or interested personnel because of rigorous scheduling. However, USATECOM position papers provided summaries of interim test reports and other test data, descriptive narrative, and conclusions and recommendations prior to the IPR, except as noted. Interim reports such as equipment performance reports, teletypes, and status reports were provided to all IPR members prior to the IPR.

(2) Initial production test (IPT) results were also examined and revealed that in several cases extensive retrofit and retest efforts were required and executed to remove serious durability/reliability problems.

(3) The Study Group concluded the following:

- USATECOM position papers, together with interim test reports, have generally provided adequate information for decisions by IPR members. Test agency final reports involve only minor changes in the basic test findings, but do provide valuable data for technical and logistic purposes. The tester should continue this practice (of not waiting for final test agency reports) when necessary in order to be responsive to the pressures of program schedules.

- In general, the USATECOM position has had a great deal of influence on decisions made, and testing has proved to be an indispensable aid to Army materiel acquisition decisions. For example, the fielding of grossly unsatisfactory vehicles has been prevented. Of course, in some cases certain factors have required that USATECOM's recommendations be modified.

- When USATECOM found that the vehicle would be suitable provided certain deficiencies were corrected, it was difficult for the IPR members to properly assess whether type classification should be deferred.

- When extensive retrofit efforts were required to remove deficiencies found as a result of testing, these were cost effective compared to the alternative of fielding the vehicles with the deficiencies.

- The thrust of current congressional and DOD directives is to shorten the entire duration of acquisition programs. This tends to put great pressure for reduction on the time allowed for test and evaluation and for correction of imperfections in design and manufacturing processes. It will be necessary to emphasize continual review of scheduling in the light of actual development and test results.

7.1.3.2.2 Regulations and Policy Guidance

(1) AR 70-10 provides detailed guidance with respect to DT policies, concepts, objectives, and responsibilities. AR 70-10 requires that the developing agency prepare a Coordinated Test Program (CTP) that describes the major materiel tests planned for that acquisition program through IPT. AR 71-3 provides similar guidance with respect to operational testing of newly developed materiel. AR 71-8, "Army Program for Test and Evaluation," a new regulation (24 May 1972), covers both DT and OT and emphasizes troop testing and operational evaluation. It is the Study Group's conclusion that these policies, when revised in accordance with AR 1000-1 and the associated LOI, will provide satisfactory guidance for test and evaluation of vehicles developed by the Army.

(2) Current policies for acquisition of nondevelopmental items require that Army life-cycle management practices be followed to the extent of describing the requirement in an abbreviated form and undergoing a military potential test (MPT). MPT must precede type classification and is an operational test under the latest guidance. The Study Group concluded that in the case of commercial vehicles, most Army testing may be waived if well-defined and effective procurement and support practices are followed. Proven acceptability of the vehicle in the civilian market over a reasonable period of time should provide sufficient data to constitute the test and evaluation. The commercial

tractor operated by the 37th Transportation Group in Europe is an example of successful fielding of a commercial vehicle without testing. MPT would be required only if Army application in a TOE unit is substantially different from civilian applications of that vehicle.

(3) Current policy for product improvement (AR 700-35) requires that consideration be given to test and evaluation, but little emphasis has been placed on this and detailed guidance is lacking. Such guidance should require a formal test program when the improvement exceeds a certain threshold. It should also indicate which tests are normally carried out in relation to stipulated program levels.

7.1.3.3 Test Duration and Sample Size

(1) The duration of each wheeled vehicle test and the number of items to be tested are important considerations, particularly if an objective of the test is a quantitative assessment of reliability or durability. Durability testing of vehicles is extremely costly and time consuming because a substantial number of vehicles must be operated under varied environmental and use conditions until durability failure occurs or end of life is reached. Assessing reliability characteristics is also costly and time consuming, particularly if the effect of age (in miles) is to be determined. If the numbers of items to be procured are relatively small, then statistically valid demonstration of durability is simply not compatible with the program. This is also true with respect to reliability, especially if reliability is quite high.

(2) Durability is a somewhat vague term. Military Standard (MIL-STD) 721B defines durability simply as a subset of reliability with no further qualification. Durability is normally stated in such terms as mileage to first failure of any major component, mileage to overhaul, or mileage to design life. The general thrust of durability is an attempt to limit the need for higher-level maintenance. The Study Group concluded that durability should be defined in AR 705-50 so as to relate to data needed to adequately support initial management decisions.

(3) As noted under the RAM-D study, Section 7.1.3.6, a DA letter (to be incorporated in AR 705-50) has been issued that states the content required in the portions of the Coordinated Test Programs (CTPs) addressing RAM requirements and test plans. The content should include sample size, test duration, and test risks to the developing and using agencies. A statistical handbook is referenced that includes detailed statistical tables and figures relating sample size

and test risks. The letter is being executed and enforced on all current CTP actions. The Study Group concludes that this recent DA action is adequate to ensure that the matters of sample size, test duration, and associated risks are surfaced for decision in a timely fashion (with respect to associated funding and schedule decisions). However, this action is not adequate to ensure that full consideration is given to approaches to durability/reliability testing that may involve lower resource consumption yet provide sufficient data to make the necessary decisions with tolerable risks.

(4) Expansion of DA guidance is required for this purpose. The guidance should include the following:

- Considerations in arriving at duration of durability tests. Durability tests should normally be continued until end of physical life, rather than terminating at design life or at occurrence of component failure. Data developed through testing well past design life is required for development of the data base to support fleet management decisions, and for economic analyses to include determination of economic life. Decisions related to durability/reliability requirements need not be delayed until the end of such testing, however. (For definition of vehicle life terminology, see Chapter V in this volume.)

- Considerations in determining sample size. A disciplined approach is needed which will relate sample size to the precision of the estimates of durability and reliability. (See Appendix 3, Annex G, Volume III, for detailed discussion.)

- Considerations in determining how much risk is acceptable and the required accuracy of estimates (e.g., size of the production buy, contractual guarantees, criticalness of reliability and durability to life-cycle costs and effectiveness).

7.1.3.4 Correlation Between Testing and Field Usage

(1) The developer uses testing to address design considerations in meeting the intended application expressed in the requirements document. The user tests items to forecast how well the items will operate in the operational environment. Recently, high-level recognition has

been given by the DOD to these distinctions. One result has been the establishment of development testing and operational testing as separate tests.

(2) The Army tester designs his tests to provide data with respect to the vehicle's capabilities and characteristics in an operational environment that represents the mission performance envelope as described in the requirements document. The Study Group concluded that for each type of Army test, the mission performance envelope does conform with that described in the requirements document to the greatest possible degree within the inherent limitations of the testing and decision processes (e.g., the Army cannot wait 10 years to determine how durable the vehicle is).

(3) The Study Group's analysis showed that improper statement of required vehicle characteristics in the requirements document and in specifications was an important cause of field problems that were not discovered in testing. On the other hand, cases were noted where unnecessarily restrictive requirements resulted in test deficiencies although the vehicles were then found capable of satisfactory field performance. Properly, the matter of correlation between mission performance envelope in the requirements document and actual field usage has been under question in recent years. The U.S. Army Materiel Systems Analysis Agency (USAMSAA) study of mission profiles for 5-ton cargo trucks (see Annex C, Volume II) shows that the actual mission performance envelope is substantially different from that described in the requirements document. The Study Group concluded that it would be desirable to expand such efforts to include most vehicle types. Further, the ACSFOR and USACDC should study this problem with a view toward arriving at definitive data on present-day actual field use of each type of vehicle. A substantial gap exists with respect to knowledge of the effects of age (in years) on vehicle characteristics because this type of information is not fed back from the field.

(4) Recent studies of 1/4-, 2 1/2-, and 5-ton truck programs have shown excellent correlation between test and field results with respect to those components that fail or require replacement most frequently. Independent study of similar data on other programs by WHEELS personnel produced the same result.

7.1.3.5 Current Test Practices in Private Industry

Besides the analysis of Army test and evaluation, WHEELS also conducted an examination of the test and evaluation facilities and

techniques of private industry. A primary objective was to determine how industry gained confidence in the acceptability of commercial vehicles. A second objective was to assess the degree to which industry testing could serve as a basis for Army evaluation. Third, industry test and evaluation practices were to be analyzed to determine possible modifications that could be made to Army practices to gain time and resource efficiencies.

7.1.3.5.1 Truck Manufacturers' Engineering and Test Organizations

(1) Personal visits were made to five major truck manufacturers' engineering and test organizations. (Details of the visits are contained in Annex G, Volume III.) The proving grounds of major auto/truck manufacturers varied considerably, ranging from very extensive to very limited facilities. One proving ground featured 110 miles of varying road conditions, whereas another manufacturer relied heavily on contracting to commercial test organizations. All manufacturers utilize public roads and highways extensively to verify performance and establish life expectancy over customer haul routes or closely simulated conditions. Such testing ensures customer satisfaction for fixed haul routes and provides for the use of optimum power and gearing. Observation of fleet operations constitutes a prime source of information regarding vehicle performance. This is especially true where warranty claims are a major consideration.

(2) Test techniques and procedures were discussed generally and observed while tests were underway. Prescribed procedures and techniques include those available from professional societies and as required by Federal regulation. Each test is designed to validate or verify specific objectives utilizing the most expedient measures, including accelerated tests such as reduced mileage over rough courses. For durability and reliability testing of complete vehicles, economics and schedule were prime considerations. Specific test mileages ranged from 2,500 to 100,000 miles. Fleet operations are the greatest source of information on high-mileage durability/reliability. Usually only one or two vehicles are tested for durability/reliability over prescribed test courses, with no attempt at statistical quantification. Rather, emphasis is placed on verifying corrective actions or finding solutions to problems. Test components, especially failures, are carefully examined to determine possible design and/or manufacturing defects.

(3) As an alternative to preclude the need for more cost and time-consuming testing, designs with substantial safety margin or

designs already proved in actual usage are relied on to ensure the adequacy and durability of commercial truck components.

(4) Extensive laboratory testing was being performed by all manufacturers visited. Tests were observed on experimental and production components including the power train, chassis frame, cab and body brackets, and sheet metal. Test techniques utilize the most advanced equipment and instrumentation to achieve maximum fleet operation simulation. For most testing, there exists a good background of performance data; otherwise, direct comparisons are made with standard or problem components. The laboratory tests are followed by installation of test components and test operation on proving ground or fleet vehicles.

7.1.3.5.2 Private Industry Testing Versus Army Testing

(1) The Study Group concluded that truck industry testing and evaluation of commercial vehicle suitability differs from Army test and evaluation primarily in the way durability and reliability are addressed. The Army attempts to statistically demonstrate adequate durability/reliability, but truck manufacturers and users do not. They depend on limited prototype testing, feedback from fleet and user operations, design experience, and laboratory component testing. The Study Group also concluded that these sources of data would be adequate for Army evaluation of commercial vehicles (as defined in the Commercial Vehicle Study, Annex D, Volume II). Army contractual documents would have to be couched in language (with respect to assurance of a durable/reliable product) consistent with the nature of the available data. This requires some deviation from usual RAM-D terminology.

(2) Although there is some variance in the proving ground course types and miles and in the sizes of laboratories (numbers of test cells and quantities of instrumentation), both are capable of satisfactorily testing commercial wheeled vehicles.

(3) Techniques and procedures are more elaborately defined for test of vehicles by Army proving grounds because of the relatively immutable requirements for military vehicles. A significant difference in test practices arises from Army utilization of vehicles worldwide over all terrain types. By contrast, the trucking industry demands vehicles especially suitable for primary highway operation or designed for off-road operation. Army testing involves greater numbers of prototype vehicles, partly attributable to the environmental requirements and a desire to statistically evaluate durability/reliability.

Little difference was noted regarding methods used for measuring performance parameters such as braking, gradeability, fuel consumption, and cooling.

(4) The test facilities and techniques of the Army laboratory and proving ground generally are comparable to industry's in utilizing advanced equipment and instrumentation. For example, the United States Army Tank-Automotive Command (USATACOM) has substantial facilities for controlled laboratory testing of complete vehicles and components under simulated dynamic field conditions.

(5) The Study Group concluded that Army truck test procedures and facilities are as effective and advanced as private industry procedures and facilities.

7.1.3.6 RAM-D Planning, Achievement, and Control

(1) Reliability, availability, maintainability, and durability are multifunctional characteristics. They describe mission requirements/capabilities, resource economy measures, and management tools. Vehicle reliability and/or availability may be a fundamental measure of mission success in certain tactical situations. Other RAM-D characteristics (such as component failure rates, vehicle repair times, and component replacement times) have significant impact on logistic resources. Both types of RAM-D characteristics must be addressed in stating vehicle requirements and specifications, and in estimates and demonstrations of achievement against requirements. RAM-D characteristics are also sometimes used as a key element in program planning and management. For example, the level of reliability at various times during development may be used as a measure of development progress (system maturity) and to identify the time, resources, and funding required to bring the development to a given level of maturity.

(2) A number of factors peculiar to wheeled vehicles tend to make their RAM-D efforts somewhat different from those of other commodities. Some of these factors are as follows:

- Tactical vehicle developments tend to be an assembly of available components, some of which are appropriately modified.

- Vehicles are relatively simple systems with relatively few parts and few redundancies (i.e., extra

parts to perform the vital functions of parts that may fail).

- The utilization, mission, and environment tend to be more variable and uncontrolled.

- Certain components have strong tendencies to wear out or deteriorate as the vehicle ages and accumulates more mileage.

One result of these factors is that reasonably accurate estimates of RAM-D characteristics are difficult to obtain unless exceptionally good engineering-type data are available. In the case of commercial vehicles, however, the amount and validity of experience data available should permit the waiving of statistical testing of RAM-D.

7.1.3.6.1 RAM-D Program Problems

(1) There is essentially no feedback data on vehicle performance capabilities (including reliability and durability) with respect to specification and mission requirements to support product improvements, new developments, commercial procurements, and RAM-D assessments. A new vehicle must be managed through its initial fielding period to achieve mature RAM-D potential. During this time, an intensive data collection effort is required to isolate troublesome components and problems caused by the way vehicles are used or supported. The Navy has developed a Data Collection Specialist Program to acquire these type data, and the program appears feasible and desirable for Army implementation.

(2) Many requirements documents and contractual specifications do not require the most important RAM-D characteristics necessary for performance capabilities in the anticipated operating, logistic, and force structure environments. Just as commonly, some requirements documents state needed characteristics in an unnecessarily restrictive manner preventing sensible trade-offs to minimize resources consumed while meeting requirement capabilities.

(3) The potential for success of RAM-D efforts was diminished by procurement procedures (e.g., placing inadequate emphasis on performance specifications, and using immature technical data packages as a basis for competition for production).

(4) RAM-D efforts were not fully integrated into all phases of the life cycle of a system. Too often the RAM-D effort was conceived

or practiced as a separate entity, not directly influencing other aspects of the vehicle program. The requirements document should be thoroughly challenged with respect to the rationale behind the stated RAM-D characteristics. The program must provide for development, test, funding, and schedule consistent with accomplishment of valid RAM-D efforts. RAM-D efforts have a great impact not only on research, development, test, and evaluation (RDTE) resources and schedule, but also on Procurement of Equipment and Missiles, Army PEMA), and Operation and Maintenance, Army (OMA), costs. Factors outside the materiel acquisition process sometimes impact negatively on RAM-D. Poor maintenance training, the lack of qualified repairmen, turbulence of operator and maintenance personnel, operational abuse of vehicles (e.g., exceeding design loads), and logistic delays directly affect the vehicle's operational RAM-D characteristics and influence the "opinion" of the adequacy of its design and production. Determining the impact of RAM-D characteristics on life-cycle ownership is an extremely soft area. A suitable feedback system is required. Second, the DOD Life-Cycle Costing Procurement Guide should be improved in this area.

7.1.3.6.2 Steps Taken To Improve Effectiveness of Army RAM-D Programs

(1) RDTE policies and procedures are being changed to recognize that reliability growth continues progressively during development and early production stages (as long as substantial engineering effort is applied).

(2) AR 705-50, "Army Materiel Reliability and Maintainability," is currently being strengthened in areas of definitions, testing requirements, and integrated logistic support (ILS) interface, and is being changed in accordance with the new policies for systems acquisition (AR 1000-1).

(3) A recent DA letter (which is to be incorporated when AR 705-50 is revised) provides guidance as to what must be contained in CTPs with respect to RAM-D. The content should include test criteria, sources of data for RAM-D assessment, duration of tests, sample sizes, mission profiles and pertinent operating/maintenance constraints, test risks to developing and using agencies, failure definition, and conditions for unscheduled termination of tests. This guidance has been implemented in both new and revised CTPs. Changes to program funding and schedule are being addressed (no vehicles are included to date).

(4) A DOD task force is overseeing "Service Studies of Defense Systems Life-Cycle Costs (Reliability and Maintainability Improvements to Reduce Maintenance Costs)." The study has three main parts: to estimate true maintenance cost (little progress has been made on this), to review several operational systems to identify critical components that impose a heavy maintenance burden because of poor RAM-D characteristics, and to review several developmental systems to ensure that the causes of poor RAM-D are not inherent traits in the new programs. Two operational trucks were reviewed. The 5-ton M809 truck review identified the clutch, transmission transfer, and rear axle wheel seal (inner) as critical components; and the 5-ton M39A2 truck review identified the engine and clutch disc as critical components. No developmental truck programs are to be reviewed by the Army.

(5) In response to the above DOD task force and other similar efforts, "RAM New Initiatives" were proposed to improve the Army's ability to reduce life-cycle costs through better application of RAM-D technology during RDTE. Although funding as a new initiative has not been forthcoming, three of the tasks are of sufficient importance to receive initial implementation by USAMC (at a low level) within prescribed resources. The first task was to examine the current Army inventory and identify design practices that cause high maintenance costs. The second task was to develop the methodology for designing mechanical equipment to a prescribed reliability and for determining the effect of increases in reliability on intensity of prototype testing. The Study Group concluded that increasing the level of effort with respect to this task would have substantial benefits to future vehicle (and other) programs. The third task was to develop the methodology and instrumentation for controlled laboratory testing of complete vehicle systems and components under simulated dynamic field conditions.

7.1.3.6.3 Recent Changes To Improve RAM-D Management

(1) The USAMC embarked on a significant program to improve RAM-D management. Hardware improvements, organizational changes, personnel training, and methodology improvements are being intensively pursued and funded. The USAMSAA has been designated as the central USAMC activity for development and improvement of RAM-D methodology.

(2) The U.S. Army Logistics Doctrine, Systems and Readiness Agency (USALDSRA) has been tasked to consider effects of RAM-D on logistics and the impact of logistic factors on RAM-D requirements.

(3) The USACDC Maintenance Agency has been designated as the USACDC agency responsible for considering RAM-D with respect to each materiel requirements document.

(4) Additional efforts to improve RAM-D include an aggressive symposium program to address mechanical and ground mobility systems. Participants of these symposiums include industry, academic, and Army personnel. Discussions have identified where effort is being applied and the progress that is being made.

7.1.3.7 Recommendations

(1) Relating to "Relationship of Testing and Management Decisions":

Have ACSFOR revise AR 11-25, AR 71-6, and AR 71-8, and OCRD revise AR 70-10 to largely waive the need for Army tests of commercial vehicles when such vehicles are procured for TOE units and the item meets the commercial vehicle definition as described in Chapter IV of this volume.

(2) Relating to "Correlation Between Testing and Field Usage":

(2.1) Have ACSFOR, with USACDC and USAMC assistance, establish definitive data on mission performance envelopes representative of actual field use for each type of vehicle, and revise USAMC test procedures accordingly.

(2.2) Have OCRD initiate a program to determine effects of age on vehicle characteristics.

(3) Relating to "Current Test Practices in Private Industry":

Have USAMC write contracts for commercial vehicles in terminology concerning RAM-D characteristics that is consistent with that used in industry.

(4) Relating to "RAM-D Planning, Achievement, and Control":

(4.1) Have DCSLOG and OCRD coordinate with the WHEELS Study Group (Phase III) to ensure that their requirements for feedback of data to support new developments, RAM-D assessments, product improvements, and commercial procurements are integrated into the wheeled vehicle management information system.

(4.2) Have the Deputy Chief of Staff for Personnel (DCSPER) and DCSLOG validate the desirability of establishing a data collection specialist program.

(4.3) Obtain FY 74 funding for OCRD to support a higher level of effort in development of methodology for designing mechanical equipment to prescribed reliability levels and for determining the effect of increased reliability levels on testing and life-cycle costs.

(4.4) Accelerate the ongoing OCRD RAM-D program improvement actions that affect wheeled vehicle programs to include:

- Methodology for relating RAM-D characteristics to operational capabilities and life-cycle costs and for establishing RAM-D requirements
- Procurement practices aimed at providing durable/reliable wheeled vehicles.

7.1.4 Logistic Support Management Processes

(1) Integrated logistic support for trucks and trailers interfaces with every aspect of the life cycle, from conceptual planning to disposal. In fulfilling the task to provide firm recommendations that will aid in resolution of current problems and serve as a basis for improving the management of the Army's wheeled vehicle fleet, WHEELS selected specific aspects of logistic support that were inherently worthy of analysis.

(2) This section summarizes the logistic support portion of Annex B, Volume II, which should be referred to when more detailed information is required.

(3) Logistic support of commercial vehicles was of overriding importance to the study of increased use of commercial vehicles, and is covered in Annex D, Volume II.

(4) The selection of logistic support topics was driven by the specific background and knowledge of the members of the Study Group and the guidance furnished the group, as well as research into related studies that caused problems to surface. The Study Group, thereby, attempted to focus on those aspects that could fruitfully yield reduced unit costs or life-cycle costs. Some of the study areas proved important and academically interesting, but the Study Group concluded that

the managerial efforts underway in those areas were sound. Thus, no recommendations for improvements are made in those areas. However, in several areas, significant recommendations are offered. The following sections identify each aspect that was studied with the resulting recommendations identified in Section 7.1.4.16.

7.1.4.1 Assets and Inventory Management

(1) Few management responsibilities parallel, in scope and complexity, that of managing the Army's inventory. Problems arise from its size, diversity, and the many echelons through which an extended materiel pipeline must reach to support the combat forces. The Army maintains a major item inventory valued in excess of $26 billion. This high dollar investment and mission essentiality of these items warrant improved reporting, accounting, and management. Intensive management of major items is necessary not only because of the investment and essentiality, but also because of the major item impact on secondary items, repair parts, special tools, associated equipment, and support requirements in the field. The inventory control and asset reporting system operates under the principle and policy that the system will provide all essential information to the commodity manager to allow him to exercise the essential supply, procurement, and financial controls.

(2) The Army uses a variety of reports to accumulate asset data for programming and budgeting decisions. The accuracy of these asset data can be improved by requiring accurate inventories annually, by automatically and systematically challenging gross error reporting, and by implementation of in-transit asset reporting developed by the DCSLOG Asset Task Group. (See "Asset Control Task Force," Volume I, Executive Summary, June 1972, ODCSLOG.)

7.1.4.2 Maintenance Management

The maintenance function within the DA is one of the larger single logistic functions in the consumption of resources. The magnitude of maintenance programs in terms of funds, personnel involved, and dynamic impact of Army materiel readiness requires economical and effective management. Maintenance materiel management entails the functions of planning for and the maintenance support of equipment. These functions begin with the development of the vehicle concept and continue throughout the life span of the vehicle. The depot maintenance (7M) program is developed by the major commands (U.S. Army, Europe

(USAREUR); U.S. Army, Pacific (USARPAC); USAMC) upon receipt of program/funding guidance from the Department of the Army. Improved materiel readiness can be achieved with present maintenance resources through increasing the repair of unserviceable tactical wheeled vehicles at the direct support and general support level of maintenance; constraining maintenance and supply support on a selected model basis; accelerating the implementation of maintenance support positive (MS+); revising the maintenance standards and policies giving additional considerations to equipment acquisition cost, density, usage, design, and operating cost; and assessing the economics of overhaul in view of the fleet excesses.

7.1.4.3 Loss Data

(1) The U.S. Army Audit Agency and the Congress (the House Appropriations Committee) have been critical of the accuracy of the Army's inventory system and use of outdated loss factors. In March 1972, the DCSLOG established an "Asset Control Task Force." Corrective actions proposed by the task force and the implementation of Major Item Management System (MIMS) (Continuous Asset Balances) and SYMWAR (Computerized Loss/Replacement Data) should alleviate the problem area. SYMWAR consumption reductions for the major trucks and companion trailers approximate $19 million using the FY 73 apportionment requirement for comparative analysis purposes.

(2) The Study Group has no major recommendations in this area.

7.1.4.4 Type Classification—Contingency and Training

(1) Type classification is a method for categorizing items or materiel on a life-cycle basis. Its importance to the materiel development phase lies in the fact that acceptance as an adopted standard is the end of development. The classification records the status of equipment from the standpoint of development, suitability, and supportability for use. It provides a record throughout the life cycle and assists in the planning for procurement, distribution, maintenance, and disposal. Tactical vehicles are type classified as development test (DT), limited production—urgent (LP-U), limited production—test (LP-T), Standard A (Std-A), Standard B (Std-B), contingency and training (C&T), and obsolete (Obs). Revised terms are now being staffed in DA.

(2) Type classification and reclassification of tactical wheeled vehicles represent a significant and critical decision point in the life

cycle of the vehicle. Classification considers the item of materiel in relation to the Army's requirement and need. It provides a uniform basis on which to judge the qualitative adequacy of Army materiel. Classification assists in the planning and execution of procurement, supply, maintenance, and disposal action for the end item and its related peculiar components.

(3) The Study Group concluded that the prime consideration for reclassifying tactical wheeled vehicles to contingency and training (C&T) should be economical supportability. Improvements can be achieved through the performance of an annual in-depth supportability study for each vehicle payload, and the intensive planning for reclassification and disposal.

7.1.4.5 Distribution and Transportation

(1) Distribution management is the control of stocks in storage, in the pipeline, due in, and due out for the entire system on both a quantitative and a monetary basis. This complex system is designed to move materiel efficiently, effectively, and economically from the manufacturer to the user. The MIDPs are prepared for tactical wheeled vehicles and provided to DA, USAMC, and major commands. These plans provide an effective means of managing the Army's major items of equipment. The MIDP is used as a basis for filling requisitions, determining logistic capabilities, forecasting and allocating future assets, determining redistribution requirements, and evaluating the distribution impact on Army materiel readiness.

(2) In addition to shortages that may exist, the tactical wheeled vehicle fleet usually contains several thousand vehicles in depot stocks or in an unserviceable condition. The MIDP reflects the most effective and economical means of providing tactical wheeled vehicles to the user, but could be improved by including all maintenance programs that provide assets for redistribution. The timely issuance of the MIDP would enhance its use and additional resources may be required for that purpose.

7.1.4.6 Programming and Budgeting

The programming and budgeting process for trucks was reviewed by the WHEELS Study Group. The system is complex, but contains adequate guidance and numerous checks and reviews. In the context of 5-year planning for PEMA acquisition, the WHEELS Study Group

has no recommendations. With respect to integration of programs and conceptual programming, see Section 7.2.2, "Management Tools."

7.1.4.7 Motor Vehicle Warranties

(1) A warranty is a manufacturer's guarantee or assurance, explicit or implied, that his goods are as represented in terms of materiel, workmanship, and design. Warranties are usually limited in terms of both time and miles.

(2) Currently, with exception of a few special cases, contract warranty clauses are utilized by the Army only for commercial items or components. Examples of the exceptions are the 3/4-ton M37 and the 1 1/4-ton M715. Major components procured under warranty have been commercial or modified commercial, such as the engines used on the M54A1, M809, M561, M123A1, and GOER vehicles.

(3) There is little recorded experience on tactical vehicle warranties on which to evaluate utility or cost effectiveness. Estimates place the cost at 0.5 to 5 percent of acquisition cost.

The Army needs to better identify the costs of warranties.

(4) Another of the significant facets of the warranty problem is the loss of warranty through unprogrammed storage periods. As an example, of the 5,500 M809 trucks delivered during March-November 1970, 9 months of the 36-month warranty period were used during the depot retrofit operations. Additional months were consumed until the truck was actually placed into use. Thus, a considerable portion of the warranty expired before the Army began to accumulate mileage. The Army needs to improve its efforts to recoup potential benefits from warranties.

(5) The standard warranty does serve to protect the Army from catastrophes, particularly in the absence of testing.

7.1.4.8 Engineering Support to Production

(1) Engineering support to production (ESP) is necessary to provide uninterrupted economical production of quality vehicles and support competitive procurements, provide drawings and technical data packages, evaluate equipment improvement recommendations submitted by using units, correct design errors, provide for ease of maintenance and reduced field maintenance, and provide for standardization, cost reductions, and alternate designs necessary to promote competition. The magnitude of the ESP effort is such that the Army has relied on the capabilities of the civilian industry to supplement the in-house effort. The FY 73 ESP effort for wheeled vehicles approaches $25 million.

(2) Despite this level of effort, serious deficiencies have surfaced in production vehicles delivered during the past few years. As a result, costly retrofit programs have been necessary. In addition, multimillion dollar improvement plans were proposed and are currently being staffed or, as in the case of the 2 1/2-ton and 5-ton trucks, have been approved for implementation.

(3) Measures are being taken by USAMC to produce military vehicles with the quality, reliability, and maintainability necessary to ensure top performance with minimal support. Measures have also been taken to improve ESP management tools and controls and to surface engineering defects early in the production stage.

(4) Further potential for reduced costs in ESP are considered feasible.

7.1.4.9 Disposal

Disposal actions are effected on approximately 12,000 unserviceable, uneconomically repairable tactical wheeled vehicles annually. During FY 72, disposal actions were initiated on 22,000 excess contingency and training assets of the 1/4-ton and 2 1/2-ton load fleets. Disposal actions were completed on 19,243 of these vehicles. The remaining quantity is being serviced with other Government agencies and through international logistics. Approximately 95 percent of the tactical wheeled vehicles released for disposal were sold or transferred to other Government agencies and international logistics. This processing cycle may take 45 days to 6 months. The delay in processing tactical vehicles for disposal can be reduced

through the implementation of a DCSLOG proposed change to AR 755-1, which is currently in staffing. This change provides the use of DOD condition codes, which permits automation; the use of predisposition instructions based on a forecast of generations; and reduced processing time. Although the predisposition instructions have been implemented by message, additional time reductions will be achieved when the change is fully implemented.

7.1.4.10 Mobilization Planning

(1) Tactical wheeled vehicle mobilization planning has been a gray area since World War II when the then existing large mobilization base was disbanded. Subsequent planning led to a minimal investment for mobilization base potentials. No Government nor commercial facilities are currently funded to perform such tasks or provide standby production potential except in the case of the minimal special tooling and equipment utilized by Consolidated Diesel Electric Company in production of the M561 and the special tooling and equipment now utilized by AM General Corporation and subcontractors in support of the production for the 2 1/2- and 5-ton trucks.

(2) Written agreements exist between the Government and various potential automotive producers for over 800 separate numbered major end items such as dollies, trucks, trailers, and semitrailers. These "agreements" are legally loose and are problematical for planning. Moreover, without the participation of General Motors, Ford, and Chrysler in all payloads, the plans become almost meaningless. Even without agreements from the major producers, the industrial capability to meet the automotive mobilization requirements are far in excess of the current computed needs.

(3) Where the needs of the Government can readily be met, the DOD policy dissuades continuing formal planning. Instead, planning priorities should be diverted to other areas. A reexamination of this policy is in order because of the current excess asset positions in major payloads.

(4) The importance of Army mobilization planners keeping apprised of civilian capabilities, changing technology, and component producers is recognized. Civilian producers, on the other hand, need to understand mobilization concepts and requirements.

7.1.4.11 Standardization

(1) Standardization of wheeled vehicles is designed to improve the operational readiness of the Army by increasing the efficiency of design, development, acquisition, and logistic support; conserving money, manpower, time, facilities, and natural resources; reducing the variety of makes and models; reducing the repair parts; and enhancing interchangeability, maintainability, and training. This is a large order because standardization also tends to slow modernization and, at times, causes the Army to specify items that are no longer being demanded by civilian industry.

(2) The Army uses a technical data package as the means to implement standardization. When latitude is given to the contractor to deviate, the Army's control can be lost. That latitude must be carefully considered.

(3) The Study Group has no recommendations in regard to the tactical wheeled vehicle standardization program other than shown in Chapter VI. Commercial vehicle standardization was addressed in Chapter IV.

7.1.4.12 Leasing

(1) WHEELS examined possible situations by which the Government's equipment requirements might be more economically satisfied by lease or rental rather than purchase. The expanded use of commercial vehicles makes this a viable alternative, whereas almost no leasing potential exists when tactical wheeled vehicles are specified.

(2) A cost-effective application arises for vehicles in the Reserve components when commercial vehicles are authorized in the TOE. REVA 23 has been approved and requires that commercial tractors enter the medium truck companies (TOE 55-18). These vehicles are used only about 37 days a year and driven less than 4000 miles annually. Based on that usage, preliminary estimates show an approximate 25 percent savings by leasing.

(3) The Study Group concluded that the operational problems, if any, could be assessed in a test case sponsored by DCSLOG. Other vehicular applications for the Reserve components could subsequently be developed.

7.1.4.13 Procurement Concepts

The Armed Services Procurement Regulation (ASPR) and other procurement directives furnish ample and voluminous guidance in the procurement field. It was believed, however, that a review of some traditional concepts regarding vehicle procurements would be helpful. These concepts were the desirability of multiyear procurements for tactical vehicles; the quantities required to maintain a hot base, if desirable, and whether these quantities should be procured annually; and the potential for should-costing and life-cycle costing for tactical vehicles. With respect to the first two, the Study Group concluded that complete economic data are not available for accurate judgments on multiyear and annual buys versus large intermittent single-year buys. The management information systems proposed in Section 7.3 will materially assist in these judgments. Considering the current asset situation, time is available to gather the required information. With particular respect to multiyear buys, increased efforts are required in obtaining forecasts of model mixes and long-range programs from other customers. With respect to the third concept, the Study Group concluded that no basis exists for procurement of tactical trucks on a life-cycle basis and that components for tactical trucks should not be broken out as Government-furnished materials solely for should-costing purposes.

7.1.4.14 Vehicle Exhaust Emissions

(1) Within the next 3 to 4 years, vehicle exhaust emission standards are expected to have a considerable impact on performance and cost of the Army tactical vehicles. Current standards restrict only exhaust smoke (HC), carbon monoxide (CO), and evaporative emissions. Beginning with the 1975 production of heavy-duty diesel engines and starting with the 1976 production of automotive and light-duty engines, very significant and difficult-to-meet (gaseous emission) control standards for the emission of oxides of nitrogen (NO_x) are proposed. Reduction of both smoke and NO_x to the proposed levels represents significant penalties to current engine combustion systems in combustion efficiency and degradation in fuel economy, which is of national concern relative to fuel and energy conservation. The inevitable power losses, higher maintenance costs, and fuel consumption associated with these standards are likewise of concern to the Army, particularly as they may impact on the combat support performance of the tactical vehicle fleet.

(2) The Army's policy in the emissions campaign has been one of full compliance with whatever levels are established by the Environmental Protection Agency (EPA). This practice stems from an Executive Order that Government agencies would assume a leadership roll in the national campaign for clean air. The Army performs research and development in this area only if its needs cannot be satisfied by industry.

(3) A study prepared for the White House Office of Science and Technology on the subject of compliance cost versus air quality benefits suggests that certain contributing segments pay a cost penalty far in excess of benefits derived when national gaseous emission abatement standards are set to meet levels required in certain localized air quality problem areas. This thesis gives emphasis to the question of whether the Army may better contribute to the national goals of the Clean Air Act through leadership in research and exploratory development of new and inherently clean and efficient combustion systems, as opposed to the high-cost/low-return for expedient compliance treatment programs for current engine systems. This effort should be applied where industrial developments underway are oriented toward near-term marketing and tooling solutions and may not effectively address the long-range national goals for air quality and fuel conservation.

(4) To better answer this question, the USAMC has been requested to conduct a cost-effective analysis of the proposed NO_x emission standards relative to the tactical vehicle fleet in accordance with the methodology of the White House report. Such a study may well suggest a redirection of the Army's efforts and resources in this technology area, particularly with respect to the heavy-duty truck engines of 200 hp and upwards. This would be similar in effort to the Army's work with the Texaco and Ford engines for light-duty trucks.

7.1.4.15 Sizes of Passenger-Carrying Vehicles

The Study Group investigated the potential application of compact size sedans for TDA. It is concluded that there are limited applications and that compacts will save the Government about 2¢ a mile over standard-size sedans.

7.1.4.16 Recommendations

(1) Relating to "Assets and Inventory Management":

(1.1) Have DCSLOG and USAMC develop procedures and implement an automated system in asset reporting that will systematically challenge gross reporting errors.

(1.2) Implement the receipt validation/in-transit reporting procedures envisioned in the Standard Army Intermediate Level Supply Subsystem (SAILS) in current logistical automatic data processing (ADP) systems.

(1.3) Include the subject of annual inventory of assets, as prescribed by AR 740-26, as an item of interest for The Inspector General.

(2) Relating to "Maintenance Management":

(2.1) Have DCSLOG accelerate the actions under maintenance support positive and expedite additional study, considering factors such as acquisition cost, usage, design, operating cost, and density as a basis for revising maintenance policies for each payload tactical vehicle.

(2.2) Have DCSLOG revise AR 750-4 to specifically empower USAMC to develop the Army's worldwide depot maintenance program.

(2.3) Curtail programming of overhaul of tactical wheeled vehicles for the U.S. Army until the economics of the overhaul and cost effectiveness can be assessed with respect to model standardization and utilization of excess assets.

(2.4) Repair unserviceable, economically repairable tactical wheeled vehicles to direct support/general support standards as applicable using TB 750-98-23 as the maintenance expenditure limit.

(3) Relating to "Type Classification—Contingency and Training":

(3.1) Run a correlation by USAMC of the age distribution/age equivalent study methodology and formula for use in developing

replacement requirements with the procedures developed by MIMS and those utilized in computing annual replacement requirements during the AMP/budget cycles and submit a draft Army Regulation to DA for approval and publication.

(3.2) Conduct an in-depth supportability study by USAMC annually in conjunction with the Army Materiel Plan for each tactical wheeled vehicle model series to include C&T.

(3.3) Have USAMC develop disposal plans and check points to ensure that C&T assets are rapidly removed from the inventory.

(3.4) Have USAMC publish supporting pages in the Major Item Distribution Plan (MIDP) reflecting the phase-out planning for C&T assets.

(4) Relating to "Distribution and Transportation":

(4.1) Have DCSLOG and USAMC develop and implement procedures to include in the MIDP all programmed overhaul scheduled for redistribution.

(4.2) Reduce the time required by USAMC to produce the MIDP from 90 days to a maximum of 45 days and publish the MIDP in phase with other budget and planning documents.

(5) Relating to "Motor Vehicle Warranties":

(5.1) Continue Government acceptance of warranties that are the custom of the trade, but evaluate the costs of the warranties by requesting prices with and without a warranty.

(5.2) Request extended warranties beyond those that are customary. Evaluate the costs of these provisions by requesting prices with and without more extensive warranty provisions as exemplified in Appendix 4, Annex G, Volume III.

(5.3) Make concerted efforts by DA and USAMC to ensure that the benefits of warranties are obtained. Include: publication of an Army Regulation outlining command responsibilities, publicity focusing upon the benfits to the user, disciplinary actions, comparative statistics, cross-checks of parts requisitions, and maintenance of service records throughout the full warranty period.

(6) Relating to "Engineering Support to Production":

(6.1) Conduct a manpower evaluation of the USATACOM capability to absorb, in-house, the ESP for vehicles and trailers not currently in production. Couple this evaluation with an economic analysis following the guidance in AR 37-13.

(6.2) Have USAMC evaluate the current Caterpillar Tractor Company ESP performance contract for the GOER and the AM General 2 1/2-ton and 5-ton ESP contracts to determine, at the end of the contract period(s), the advantages, disadvantages, cost effectiveness, and performance of a single contractor charged with the total ESP and production effort.

(7) Relating to "Disposal":

Have USAMC expedite implementation of DCSLOG's proposed change to AR 755-1 which provides for automated use of predisposition instructions and reduced processing time for disposal actions.

(8) Relating to "Mobilization Planning":

(8.1) Have USAMC consider the WHEELS AAOs in mobilization planning and reexamine the planning priorities accordingly.

(8.2) Revise DCSLOG policy requiring the inclusion of warm base mobilization production schedules in the AMP to require inclusion of the actual base condition.

(9) Relating to "Leasing":

(9.1) DCSLOG, in coordination with Chief, Office of Reserve Components (CORC), and other Staff agencies, sponsor a 1-year test during FY 74 of leasing 5-ton commercial tractors for selected Reserve medium truck companies.

(9.2) Have USAMC lease commercial tractors for the Reserves under guidance from DCSLOG in coordination with CORC and other Staff agencies, if the test defined in (9.1) is successful.

(9.3) Proceed with leasing of other size vehicles for Reserves in FY 76, with initial priority on 20-ton commercial dump trucks and commercial 1 1/4-ton trucks, provided the tractor leasing in (9.1) is successful and an analysis shows that leasing applies to other payloads.

(10) Relating to "Procurement Concepts":

Support all multiyear program proposals by an analysis that compares the multiyear alternative to a single-year buy alternative for the entire multiyear quantity.

(11) Relating to "Vehicle Exhaust Emissions":

Complete the cost-effective analysis of the proposed 1975/1976 Gaseous Emission Standards now underway by USAMC at the earliest possible date, with a target for submission of 15 January 1973. Based upon the results of the USAMC analysis, reassess the Army's current policy and direction of efforts in the exhaust emission campaign.

(12) Relating to "Sizes of Passenger-Carrying Vehicles":

Modify AR 58-1 to incorporate the requirement to specify compact sedans in TDA wherever suitable.

7.1.5 Cost Management Processes

The last, but still extremely important, part of tactical wheeled vehicle management concerns itself with cost aspects of the management process. Cost considerations pervade management decisions and dictate economically oriented vehicle management. The costing effort must be dynamic to assess requirements for both present and future inventory systems to provide decisionmakers with a proper background for flexibility in vehicle planning, programming, and budgeting. Through the process of its analyses, the WHEELS Study Group acquired a comprehensive perspective of the cost aspects of vehicle management. In the following sections, the important costing areas are identified and the data available are evaluated. An overview of a responsive cost system is provided, and recommendations are made for improvements in the system.

7.1.5.1 Required Costs

(1) Management decisions involve different costs that can be analyzed at various levels. Estimates may assess the cost for resource requirements, determine the costs for alternative resource allocations, or analyze the value of these alternatives.

(2) AR 37-18 is the Army policy document for definitions of cost categories and elements for Army-wide estimates. This document provides a base for commonality and completeness in cost reporting. It is structured for reporting research and development, investment, and operating costs. Each of these cost categories is subdivided into various cost elements for Government- or contractor-incurred costs. Further visibility is provided through a breakdown of cost elements into appropriate work breakdown structure levels according to MIL-STD 881. The usefulness of cost reports in this format has been widely recognized, and the use of these reports is well established within the cost community of the Army for analytical evaluation in support of management decisions. Periodically updated, AR 37-18 is essential as a means for establishment of Cost Estimating Relations (CERs), costing of developmental systems, cost-effectiveness studies, life-cycle costing, force planning, development of cost handbooks, and studies relevant to long-range vehicle planning.

7.1.5.1.1 Available Costs

(1) Because of centralized locations and the existence of certain well-documented historical data kept by the Army and the industry, some costs are more readily available than others. Driver and maintenance personnel costs are, by far, the best documented. The data are summarized and periodically updated by military occupation speciality (MOS) and grade level in the Summary Cost Data Book for Army Managers.

(2) Acquisition costs are reasonably well recorded in contractor data at the Procurement and Production Directorate and the project/product manager level, USATACOM. A breakout of costs according to AR 37-18 is often difficult to obtain for those systems that have been in the inventory for some time. In the past, most contractor costs were not reported in accordance with current procedures and now require "purification" of cost data. Recently acquired systems can be more readily compared because they conform with AR 37-18. Much emphasis has been placed on the learning curve technique for computing the average unit cost of a given procurement quantity of items. This technique is valid only when manufacturing is uninterrupted, with no configuration changes of the system during the production phase; program stretch-out does not occur; and the manufacture of the quantity to be procured is being accomplished by one prime contractor. All of these conditions are seldom met in procurements of military systems. The indiscriminant application of the learning curve technique therefore tends to lead to erroneous

unit cost computation. Although this technique may be adequate for cost projection and cost-effectiveness analyses of the systems under development, a more realistic cost/quantity relation must be applied for systems under procurement.

(3) The total annual cost of petroleum, oils, and lubricants (POL) for military vehicles is relatively small compared to other operating costs, and the dollar difference between comparable vehicles has little impact on a cost comparison. Quantitative POL data can be obtained from The Army Maintenance Management System (TAMMS) for fuel and oil consumed, and their cost is reported by the Army Petroleum Center.

(4) Transportation costs for all theaters are available in the Army Force Planning Cost Handbook on a dollars-per-short-ton basis. Use of this handbook is ideal for computing transportation costs for vehicles because their weight is readily available from technical data sheets. Transportation costs for initially provisioned parts and annually recurring maintenance repair parts cannot be obtained in this fashion because their shipping weights are unknown. Shipping records are available only on a gross tonnage basis and do not provide the detailed visibility needed. At present, transportation costs for these parts are computed by applying factors to their acquisition costs. It is recognized that this is not the best method, but in lieu of better data, it is the one presently accepted.

7.1.5.1.2 Not Readily Available Costs

(1) Some essential costs are difficult to obtain for a variety of reasons, the most frequent being the lack of both an adequate data base for the entire fleet and a firm methodology for deriving these costs.

(2) Contractor costs are enumerated separately and in sufficient detail only for the newer vehicles in the fleet. The data are available in vehicle contracts. For vehicles procured prior to the advent of AR 37-18 and the life-cycle costing methodology, it is difficult to separate cost categories such as recurring and nonrecurring investment. Cost analysis must continually apply comparison and factoring techniques to complete their cost comparisons and cost-effectiveness studies.

(3) Initial provisioning cost is obtained by factoring the hardware cost of a vehicle. The factors are based on logistic experience depending on vehicle type, mission profile, commonality of parts between vehicles, and their density. Cost analysts, at their own discretion, have been using factors ranging from 8 to 15 percent for initial provisioning. The wrong choice of these factors can lead to inaccurate statements of resource requirements and serious logistic repercussions.

(4) Operating costs are the greatest single cost in the life of a vehicle, and the one for which the least reliable data are available. Next to driver cost, repair parts cost and maintenance labor cost are the two main contributors to operating costs for tactical wheeled vehicles. They are especially significant in a comparison between military and commercial vehicles. At this time, the most accurate source for repair parts cost for tactical wheeled vehicles is obtained from an analysis of the Item Application File (IAF). It must be adjusted by actual issue data because there is no readily available recurring report of this nature. The cost of repair parts for commercial vehicles is sometimes difficult to obtain. It is extremely difficult to assess and compare military and commercial vehicle repair parts consumption.

(5) Annual maintenance labor hours have been obtained from the TOE Manpower Authorization Standards and Criteria (MACRIT) reports. However, their validity is questionable because they represent maintenance time study results and not actual field requirements. TAMMS attempts to report actual field data; however, this information was not used because of inconsistencies in reporting. Commercial vehicles are reported for a wide gross vehicle weight (GVW) category, and separate vehicle visibility is lost. The maintenance labor cost is an important consideration in the comparison of candidate commercial substitutes with proposed new military-design vehicles. This task could be accomplished more readily and yield more meaningful results if accurate maintenance labor data were available.

(6) Depot overhaul is another element of great importance in a life-cycle cost comparison of alternate vehicles. The economics of overhauling vehicles from a cost-effectiveness standpoint has yet to be determined, and several tests are currently being conducted in this area. Vehicle depot overhaul cost estimates and transportation costs are available for CONUS, Europe, and the Pacific depots. The information needed to break out the direct labor costs, funded and unfunded parts costs, and overhead costs for depots in any of the theaters is not readily available.

(7) Logistic support costs consist of "wholesale" and "retail" costs. The wholesale costs cover the management activities in support of the vehicle at the national inventory and national maintenance points, and supply depots worldwide. The retail portion includes post, camp, and station supply operations as well as worldwide storage and issue costs for vehicles and their repair parts. These costs have proved to be very difficult to identify, but they are important for comparison of military and commercial vehicles.

7.1.5.1.3 Problem Areas

The lack of firm readily available cost information for Army systems in general and for tactical wheeled vehicles in particular has become most evident during the conduct of WHEELS. These shortcomings have impeded the cost analysis effort of the study. Inconsistencies of information, in some cases received from different offices within the same commands, required extensive analysis and judgment. Data are scattered and buried in many offices, each one generally being concerned only with information directly related to its particular function. No effective effort to consolidate these data is apparent. Even though it is good management practice to divide tasks into more easily managed segments, there must be a centralized effort to coordinate the decentralized information sources now in existence. Part of this problem can be overcome by improving sampling techniques, simplifying reporting formats, and minimizing human errors. It must be emphasized that because the management process is dynamic, it must be supported by an equally dynamic cost system to provide the necessary flexibility for decisionmaking.

7.1.5.2 Cost System

Theoretically, the cost system functions well in its primary role of support to management. However, the practical implementation of generating and processing the required cost information and delivering it to the decisionmaking level is cumbersome, time consuming, and somewhat suspect. The vastness of systems for which costs must be maintained leads to much duplication of effort. Proliferation of data, generated and disseminated by too many Staff agencies and commands, has caused considerable difficulty in the past. Data were used out of context as substantiated in cases such as the MBT-70, M60A2, M561, and M715/705. At best, costing serves as a rational point of departure for decisionmaking. Bearing this in mind, a concise statement of cost requirements is needed to eliminate much of the duplication of effort presently existing.

7.1.5.2.1 Cost Collection

Cost collection is the root of a sound cost system. Its importance has been greatly underestimated. Instead, the development of models has received greater emphasis as a tool for the solution of management problems. The fact that a model output can only be as valid as its input data often receives secondary consideration. Availability of data is the basic requirement for systems management. It provides the foundation for analysis of alternatives, projection of quantitative impact of decisions, and assessments of the effectiveness of management decisions. The data, prior to being used in decisionmaking, must be approved by the Department of the Army. The dangers and frustrations of diverse costing estimates and procedures are too manifest to allow otherwise.

7.1.5.2.2 Analysis

The analysis of field data begins at the major item manager's level where raw data are stored and maintained in a periodically updated data base. The data base should be functional and responsive, providing visibility for each wheeled vehicle type and class by geographical location. Specific areas of analysis performed at the major item manager's level should highlight quantitative information regarding age distribution, utilization rate, downtime, parts consumption, and indirect and direct maintenance requirements as a function of vehicle age. Section 7.3 of this chapter discusses the establishment of a management information system (MIS) to support vehicle decisionmaking. Supported by the MIS, cost data will serve as building blocks for the following types of qualitative analysis:

- Cost analysis (a measurement of economic requirements)
- Cost benefit analysis
- Economic analysis
- Force structure cost analysis
- Life-cycle cost analysis
- Sensitivity analysis.

7.1.5.2.3 Utilization

Cost information derived from quantitative and qualitative analyses supports decisions, policies, and procedures at almost every level of vehicle management. At the base of the cost pyramid, most raw cost data are assembled and maintained in data banks. These data will serve to establish vehicle procurement/replacement policies, economics of overhaul, and interrelated logistic decisions for worldwide wheeled vehicle operations. Particularly important are cost-estimating procedures and managerial methods of evaluating cost estimates for new systems at various stages of their development. The main recipients within the Army of tactical wheeled vehicle cost information are the Assistant Chief of Staff for Force Development, the Deputy Chief of Staff for Logistics, Comptroller of the Army, and the Chief of Research and Development. Each one of these Staff agencies utilizes cost data to varying degrees depending on their specific functions. Combined, they support the various Army Secretariats, the Secretary of the Army, and the Secretary of Defense with cost information related to developing, equipping, training, and maintaining vehicles in the Army.

7.1.5.3 Vehicle Management Cost File

Although serious deficiencies exist in some areas of vehicle cost, a voluminous amount of individual wheeled vehicle data is available. In most cases, however, it is outdated and fragmented among various Army agencies and commands. Often, the data cannot be retrieved in time for analytical requirements with a short suspense date. If field data collection and its subsequent analysis are to be of any value to the manager, the data must be updated expeditiously and periodically as well as meaningfully documented. Such documentation should appear in a management summary handbook similar in format to that of the Weapons Cost Data Handbook (WESCOD) published by the Comptroller of the Army (COA). In its present format, the WESCOD is structured for systems presently under development and those developed in recent years. The GAMA GOAT/M561 and the GOER family of vehicles are two such systems included in the WESCOD.

7.1.5.4 Recommendations

(1) Have COA amend AR 37-18 as follows:

- Change cost element 4.014 (integrated logistic support) to include the "retail" portion of integrated logistic support for systems in the field.

- Change cost element 4.016 (depot maintenance) to include indirect maintenance costs (i.e., all costs incurred within or controlled by the depot maintenance activity, costs for all funded or unfunded parts consumed during depot maintenance of a system, and general and administrative expenses incurred outside the maintenance activities, but that indirectly benefit these activities).

(2) Have USAMC annually update tactical wheeled vehicle repair parts factors to reflect actual issue data and usage for future wheeled vehicle cost analyses.

(3) Provide assistance by COA in development and use of a management information system to support vehicle management (see paragraph 7.3) by coordinating the acquisition, processing, and assessment of cost inputs used in the system.

(4) Have COA, with the U.S. Army Field Operating Cost Agency as the executive agent, coordinate the development of a vehicle management cost file that will be responsive to all levels of vehicle management. This cost file should provide for basic quantitative and qualitative cost information for all wheeled vehicles.

(5) Have COA develop and maintain a current management cost summary handbook containing pertinent system information and the life cycle for wheeled vehicles. Continue examination by the WHEELS Study Group during the conduct of Phase III.

7.2 MANAGEMENT ORGANIZATION

7.2.1 General

(1) On the following page is a listing of the primary problems encountered in wheeled vehicle fleet management.

- Complexity of vehicle fleet management
- Lack of an integrated approach to vehicle fleet management
- Lack of adequate management information
- Insufficient high-level visibility
- Pervasive nature of vehicles.

(2) A glance at the scope of Section 7.1 is sufficient to gain an appreciation of the inherent complexity of managing the tactical wheeled vehicle fleet. The problems involved become apparent when one attempts to visualize a single organizational structure that can coordinate and integrate the management of the fleet. System management is a fundamental objective of the Army, as evidenced by a review of the current DA Staff responsibilities. The planning, coordination, and supervision of a vehicle life cycle are divided between the Chief of Research and Development (CRD) and the Deputy Chief of Staff for Logistics (DCSLOG). However, the Assistant Chief of Staff for Force Development (ACSFOR) has overall responsibility for vehicle life-cycle management and for Army combat development activities. Any attempt at reorganization to improve management of the fleet must be conducted while keeping system management as a primary objective and recognizing the ability of ACSFOR to accomplish it. Because CRD, DCSLOG, and other chiefs of DA Staff elements have related responsibilities, a structure must be devised that recognizes those individual responsibilities, but provides integration through the ACSFOR structure.

(3) Despite the fleet size and heavy demands placed on it, only a limited number of personnel are assigned duties primarily related to wheeled vehicles, which means that those personnel who are assigned find themselves under a heavy day-to-day workload. For example, the wheeled vehicle life-cycle management and combat development activities for which ACSFOR is responsible, are carried out by three hardware action officers in the Tactical Vehicle Branch of the Systems Directorate. These men lack the time to integrate the varied wheeled vehicle related actions and to perform overall planning, analysis and/or evaluation related to the vehicle fleet. The situation in other Staff elements is similar. It is amazing that the vehicle program has been handled as well as it has.

(4) The recent change in direction of the vehicle program in reduction of requirements and near-term procurement, the effects of emission control standards, and the increased percentages of commercial vehicles to be introduced into the fleet will further increase the complexity of wheeled vehicle management. Basic changes influence not only new production but the existing fleet and the related maintenance, supply, personnel, and information systems.

(5) Full integration of management for the wheeled vehicle fleet is an elusive goal at best. This is true in part because of the impact on the wheeled vehicle fleet by other military systems, which range from routine supply systems to sophisticated weapon systems. As new developments occur in these systems, there is an accompanying increase in the need for mobility, either in the form of additional standard vehicles or more specialized vehicles. Normally the new needs are absorbed into the vehicle fleet requirements without consideration of the overall effect they will have on the fleet or the Army. Examination of the REVA discussed in Chapter II will provide an insight into the increased requirements possible when vehicles are added without consideration of the overall fleet. A related factor in the lack of integration is the absence of continuing review of the present fleet so that the costs and effects resulting from the addition of vehicles to the fleet would be readily available. This would eliminate the consideration of trucks on an individual basis (which potentially leads to excessive requirements for trucks) and result in decisions based on a fleet-wide consideration.

(6) The current decisionmaking environment demands the information necessary to make valid evaluations and reach logical conclusions. Cost factors are of primary concern and yet credible costs for wheeled vehicles have not been available. With the exception of costs for petroleum, oils, and lubricants (POL) and operating personnel, records of operating costs are scarce. Thus, accurate forecasting of vehicle operating costs has been impossible. Other information vital for efficient management has been no more readily available nor acceptable than cost information. The development of a workable, integrated information system is a must if wheeled vehicle management is to progress positively.

(7) The Army's wheeled vehicle program has not received the visibility and high-level attention that its size, scope, and complexity warrant. Although actions of a problem nature usually reach the general officer level, those involving system plans, analysis, and evaluation rarely reach that stage and, thus, seldom receive appropriate

attention. The level of visibility of the wheeled vehicle program also seems low in comparison with other major systems (e.g., helicopters, air defense, and combat vehicles) and should be raised to a comparable level.

(8) Throughout these considerations runs the pervasive quality of wheeled vehicles. This pervasiveness is in part caused by the sheer size of the fleet; however, there are other even more significant factors. Every phase of Army movement requires mobility, much of which is provided by wheeled vehicles. This means the dispersion of vehicles to every global location where elements of the Army are situated. Once a vehicle enters the fleet, it enjoys a relatively long life span ensuring its familiarity to and acceptance by many phases of the Army system. Finally, the extensive support systems necessary to maintain vehicles increase the total body of individuals knowledgeable about and involved with wheeled vehicles. Thus, changes that affect wheeled vehicles have many far-reaching repercussions and the number of people affecting and effecting changes within the wheeled vehicle system increases the difficulties inherent in changing such a large system.

(9) Recommendations concerning organizational revision will be deferred until all aspects of the management problem have been considered and the revisions necessary initiated during Phase III of WHEELS. However, this section will make major management improvement recommendations dealing with management tools.

7.2.2 Management Tools

7.2.2.1 The Program

(1) The major requirement to revitalize and redirect the management effort related to tactical wheeled vehicles is to define the purpose of such an effort and establish obtainable goals. The purpose, simply stated, is to provide vehicular support to the Army in the accomplishment of its varied roles and missions. The goal in support of this purpose is to optimize this support, which is to say that vehicular support must be in the form of the most cost-effective fleet mix that is capable of getting the job done.

(2) Because of the slow speed of technological change in industry, the size of the vehicle fleet, and the length of time required

to influence fleet composition, the target time frame must be realistic. It should be of longer range than the Five Year Defense Plan (FYDP) to take into account projected research and development (R&D) in both Government and private industry, and to permit visibility of fleet revisions resulting from procurement, product improvement, overhaul, reclassification, and disposal actions. The program must be dynamic, and several cycles may be in operation simultaneously and impact each other.

(3) The conceptual program should include:

- Determination of vehicle requirements as of the end of the planning period by obtaining data on force levels and dispersion, types of units, anticipated missions and areas of operation, types and configurations of vehicles, and necessary characteristics or capabilities

- Determination of assets, including current, planned procurement according to five year plans as well as longer range acquisition forecasts

- Determination of needs through comparison of assets and requirements

- Surveys of industrial capability to accomplish development and production to meet these needs

- Determination of Army capability to obtain assets to satisfy needs, including projected fund availability, industry capability, tradeoffs, potential for overhaul or rebuild as opposed to procurement, and timing

- Determination of priorities and methods for accomplishment.

7.2.2.2 Systems Program Review

(1) Coordinated management of wheeled vehicles as a program has been, for the most part, weak. This has been caused primarily by a lack of senior officer involvement, stemming from the "acceptance" of vehicle support, the "nonexotic" nature of wheeled vehicles, and the lack of consideration of wheeled vehicles as a single support system. Senior staff officers must become more involved.

(2) DA already has in existence a management tool for senior officer review of major or "problem" programs—the Systems Program Review (SPR). Wheeled vehicles fit the criteria established for the SPR because of size, high priority, and problems. The magnitude of the impact of wheeled vehicles on the Army mission alone justifies favorable consideration. Add to this the value of the investment (approximately $3.5 billion), the annual procurement, and operating and maintenance costs, and the need becomes more evident. To address the problems associated with the fleet, the management-by-exception principle, as envisioned by the Chief of Staff, Army (CSA), in creating the SPR, is applicable. The Tactical and Commercial Wheeled Vehicle Program should be included in the SPRs.

(3) The WHEELS Study Phase II Report provides the most comprehensive review of the many major issues being or in need of being addressed by senior managers. The Phase III WHEELS effort, terminating around 1 April 1973, is to coordinate and assist the Staff in the implementation of approved recommendations of this detailed study. Accordingly, an SPR in the third quarter of FY 73 as Phase III draws to a close would provide an ideal means for the Vice Chief of Staff, Army (VCSA), to review the final WHEELS product and the progress of Staff implementation actions as well as to give direction for follow-on programs.

7.2.2.3 The Department of the Army System Staff Officer

The Department of the Army System Staff Officer (DASSO) management concept was examined to determine its applicability, as a management tool, to the diversified wheeled vehicle fleet. Because of this diversity and the breadth of the vehicle program, a single DASSO seems inadequate to provide the required expertise and visibility on the DA Staff necessary to enhance the management of the wheeled vehicle fleet; but the Study Group does not believe that multiple DASSOs would be desirable at this time. However, it would be appropriate for the ACSFOR to further review and consider the DASSO requirement for individual programs in the future.

7.2.2.4 Information Requirements

Information requirements for the senior Army officials are conceptually simple. In basic terms, they consist of:

- An acceptable program supporting Army objectives and complying with Department of Defense guidance and national priorities

- Knowledge of the status of current and forecast programs
- A means to compare and evaluate the status against the program.

Costs and effectiveness are primary elements of all required information. The importance of cost information to the manager and decisionmaker is readily evident. However, without effectiveness, costs will not provide a sufficient basis for evaluation. Time impacts upon and is a major supporting factor in both cost and effectiveness considerations. The management information system proposed will incorporate, integrate, and, where necessary, improve existing systems and add a means to provide information not currently available (e.g., availability rates, economic life, mobility indices, and economic fleet mixes). Information requirements and the management system necessary to manipulate and provide the information in the proper form are discussed in detail in Section 7.3 and Annex I, Volume III.

7.2.2.5 AMC-71 Ground Mobility Model

(1) The AMC-71 Ground Mobility Model (discussed in Section 5.3.1) has provided projected performance data on alternative vehicular types (military standard, military derated, and commercial) in selected payload categories. Such data have been extremely useful to the Study Group in establishing a rational basis for developing viable vehicle substitution policies while still retaining current fleet characteristics.

(2) A careful consideration of the data and methodology embodied in the model, even in its present developmental state, represents a sound approach to comparing competing vehicle types where compatible field comparison data are inadequate or completely lacking.

(3) The AMC-71 Model, with continued development, has real potential for supporting meaningful specifications of mobility requirements in the combat developments process, and for providing a means to quickly assess the utility of alternative design parameters during the concept formulation, contract definition, and engineering development phases of the research, development, test, and evaluation (RDTE) process.

7.2.2.6 WHEELS Fleet Model

The WHEELS Fleet Model (discussed in Section 5.3.2) was used extensively during the latter stages of Phase II of this study for estimating the combined impacts of Tactical Vehicle Review Board (TVRB) results, the Recommended Vehicle Adjustments (REVA), and a number of vehicle substitution policies. The model also has been very useful in providing definitive information on the distribution of TOE vehicles by type, function, and location within a type theater of operation, and by mobility requirement. Based upon this experience, the WHEELS Study Group has found that:

- The WHEELS Fleet Model currently represents a valuable tool for supporting fleet analyses because it provides data on fleet characteristics not otherwise available.

- Time limitations of Phase II have prevented the full use of significant data currently contained in the WHEELS Fleet Model task data base, including data on projected vehicle usages, vehicular radio distributions, vehicle densities associated with special items of equipment (i.e., component generating items) not normally identified in AAO projections, and fleet trailer distributions by function, location, and the like.

- Pending the development of improved management information tools for the total Army wheeled vehicle program, the WHEELS Fleet Model provides a readily available mechanism for storing, assessing, and updating vehicle/fleet data relating to requirements, capabilities, and life-cycle costs.

7.2.3 Personnel Skills

(1) To establish a viable program for tactical and commercial vehicles, and once established, to retain the management capability, it is necessary to more closely assess personnel skill requirements. Authorized positions should have stated requirements that, when met, would provide personnel with the experience and educational background necessary to perform effectively in that job.

(2) To obtain the technical background and experience necessary, the majority of the positions should be designated from the

appropriate specialty areas (i.e., Logistics, Operations Research/ Systems Analysis (ORSA), Comptroller, Procurement, and R&D). Because criteria, data collection, program development, and analysis of field data input will be major requirements for systems management, a portion of the assigned staffing should be ORSA oriented. Desirable HQ, DA, assignment prerequisites include previous experience in HQ, U.S. Army Materiel Command (USAMC) or one of its subordinate commands, a battalion command, and General Staff. An engineering, business administration, or management background has an obvious benefit, if available.

(3) It is recognized that this plea is not unique to the wheeled vehicle area, but applicable to and valid for most DA Staff assignments. However, because of the lack of visibility and attention afforded wheeled vehicles in the past, personnel priorities usually have been applied elsewhere, resulting in a lower qualification and experience level in the wheeled vehicle program than its size and complexity warrant.

7.2.4 Structure

7.2.4.1 Headquarters, Department of the Army

(1) The present structure for the management of wheeled vehicles needs reorientation to increase executive emphasis and direction. The structure has evolved over the years with the absence of definite advanced planning and analysis. The resulting approach to management of vehicles is essentially budget oriented. This has permitted the existence of shortcomings such as:

- Management of individual hardware items rather than comprehensive fleet management
- Low visibility, combined with miscellaneous support systems
- Lack of a systems viewpoint on the part of action officers
- Deterrence of integrated planning below the highest levels.

In spite of structure, manpower constraints, and the "inertia" of the system, most essential actions involved in day-to-day requirements are being accomplished. However, this accomplishment too often follows the "fire brigade concept."

(2) Some immediate change in DA Staff organization perhaps could alleviate, to some degree, the problems identified. However, the WHEELS Study Group is sensitive to the all-too-common conclusion that reorganization is always the first step. This is reorganization just for reorganization's sake. During the study period there have been significant and positive reactions from the DA Staff and from field agencies addressing the many ills identified by the Study Group. Phase III will see acceleration of these corrective actions, plus the implementation of others as approved. Any significant restructuring of the DA Staff agencies concerned with vehicle program management pending a review of these positive measures would be premature and could interrupt or delay the improvements promised.

(3) Ensuring a fleet responsive to the operational and support requirements of the Army, while keeping resources to minimum essential levels, will require increased emphasis on the forward-looking facets of management and an increased requirement to infuse the systems approach. A long-range plan should be developed, along with a comprehensive management information system and an improved method for developing life-cycle and total systems costs. To accomplish this and still continue management of ongoing operations, additional personnel with specialized skills are required. The means of promulgating the necessary shift in emphasis from thinking of vehicles as individual items of equipment to considering the vehicle fleet as a major integrated support system will require continued development.

(4) A precise definition of the organization changes necessary is a function of the mechanism of management. Specific requirements are dependent on approval of a program, definitized requirements for management information, and the determination of optimum interface levels among the Army Staff and between HQ, DA, and major commands. This task will be continued during Phase III and specific recommendations will be developed as the conceptual plan is definitized. Accordingly, no change in the Army Staff organization is recommended pending completion of Phase III. Any changes must be contingent upon success during that period in the development of a totally integrated and cohesive mechanism for management. The small number

of personnel scheduled to pursue the objectives of Phase III can serve as an intensive "ad hoc" management unit to complement and assist the current vehicle management structure in each of the DA Staff offices. Upon conclusion of the WHEELS Study, these personnel, with the expertise accrued from experience on the study, should be made available as cadre for the DA Staff organizational change defined and approved.

(5) In general, the tasks required of this management unit are to:

- Bring all approved recommendations under the disciplines of the DA administrative system
- Identify and monitor ongoing studies which become significant elements of the overall vehicle management process
- Provide assistance in:
  - Development of a management information system
  - Development of improved costing
  - Development of a long-range wheeled vehicle plan
  - Identification of RAM-D requirements
- Initiate actions necessary to provide for integration of the various management processes applicable to the vehicle area
- Complete Study Group actions related to:
  - Evaluation and refinement of management indicators
  - Improvement, operation, maintenance, and preparation of the models used in the study for transfer to the responsible agency.

Preparation of the Phase III Report, to include FY 75-79 Program Objectives Memorandum considerations.

7.2.4.2 Other

To develop a systems approach for the management of wheeled vehicles requires examination of the effect on the DA Staff of the Secretariat, and major subordinate commands and the interrelationships between them. Further examination of these relationships will be performed during Phase III, taking cognizance of ongoing reorganizational efforts.

7.2.5 Conclusions

(1) A comprehensive examination of the wheeled vehicle management organization is necessary during Phase III. Consideration must be given to ongoing management/organization studies, and to the totally integrated and cohesive mechanism for management of wheeled vehicles, involving both HQ, DA, and the major subordinate commands, with special attention to USAMC and USACDC roles therein. Necessary intensive management required during the development of the mechanism will be performed by the residual element of the Study Group, complementing and assisting the current DA Staff elements.

(2) The need exists for a definitive conceptual program, the implementation of which will enable the Army to develop the most cost-effective wheeled vehicle fleet capable of supporting mission requirements.

(3) To manage wheeled vehicles in the Army as an integrated system, managers at all levels must become more involved and must recognize and fully support the position that the vehicle fleet is a system as opposed to individual items of equipment. The addition of the Systems Program Review mechanism can provide the direction and impetus essential to a dynamic program.

(4) The AMC-71 Ground Mobility Model provides a significant and useful capability to predict vehicle performances, including assessments of related materiel and terrain factors. The model and its associated research effort represents a most encouraging and promising effort in the area of ground materiel development. Its continued development should be supported.

(5) The WHEELS Fleet Model is a valuable tool for supporting future fleet analyses. It has not been fully exploited because of the time limitations of Phase I and Phase II. The model should be designated a DA planning tool and should be used and maintained by the Study Group during Phase III of the WHEELS Study, in preparation for transfer to OACSFOR.

(6) Changes to the DA organization for management of wheeled vehicles would be premature at this time.

7.2.6 Major Policy Recommendation

Change AR 10-5 by adding subparagraph (14)(h) to paragraph 2-31a, which enumerates the responsibilities of ACSFOR. The introduction to 2-31a(14) reads, [ACSFOR shall be responsible for the] "overall coordination of the following activities to include provisions of the single Army contact point for these activities:"

> (h) Determination of requirements for wheeled vehicles, including analysis of the total wheeled vehicle fleet in terms of tradeoff between mission, function, and type, while seeking the most cost-effective fleet that will meet all tactical and administrative needs.

7.2.7 Other Recommendations

(1) Continue examination by the WHEELS Study Group during the conduct of Phase III of the wheeled vehicle management organization, including HQ, DA, and major commands. Considering the integrated management mechanism and related program, make final recommendations concerning wheeled vehicle management organization.

(2) Designate the Tactical and Commercial Wheeled Vehicle program as a subject for Systems Program Review.

(3) Continue the development of the AMC-71 Ground Mobility Model fully supported under continued USAMC sponsorship with the objective of its establishment as a DA management tool.

(4) Disseminate information on the current and potential capabilities of the AMC-71 Ground Mobility Model and its supporting research to all DA elements involved in vehicular ground mobility, combat developments, and RDTE efforts.

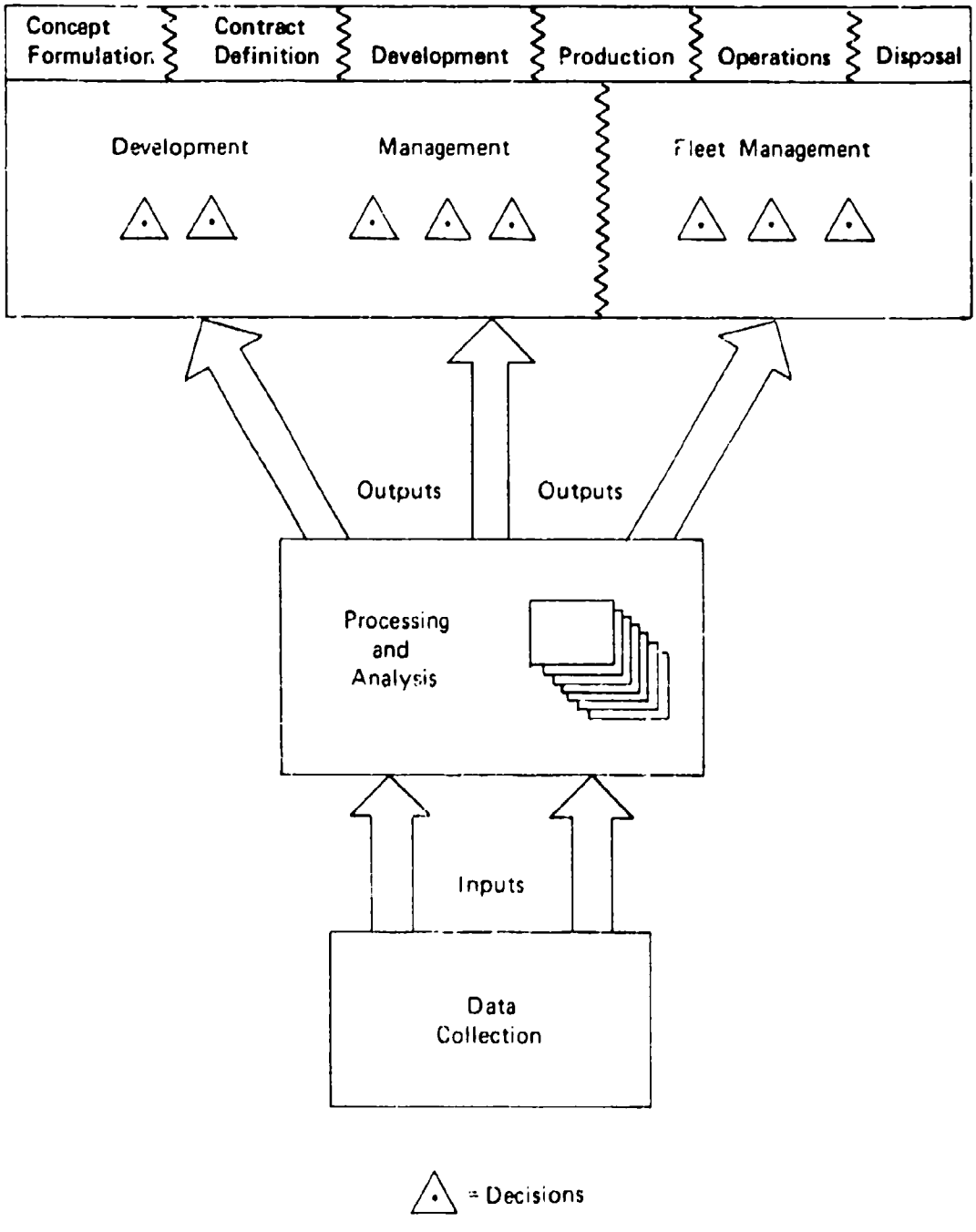


FIGURE VII-4. INFORMATION SUPPORT OF VEHICLE MANAGEMENT

(5) Designate the WHEELS Fleet Model as a DA planning tool and approve its use, maintenance, and continual updating during Phase III by the WHEELS Study Group in preparation for transfer to the OACSFOR.

(6) Develop and implement specific procedures during Phase III that will provide for appropriate USACDC and USAMC updates to the WHEELS Fleet Model data base in the respective areas of new SRC vehicular task descriptions and revised vehicular life-cycle parameters. Investigate means of improving the current interface between the WHEELS Fleet Model and the OACSFOR SACS.

(7) Direct no organizational changes with respect to wheeled vehicle management at the DA Staff level in consideration of the positive ongoing actions by the DA Staff, major commands, and WHEELS Phase III.

7.3 MANAGEMENT INFORMATION SYSTEMS

(1) Management is only as good as the information available to the manager. To be effective, a vehicle management information system (MIS) must provide timely and accurate information to the appropriate decisionmakers. The following paragraphs address the requirements for information support of vehicle management.

(2) The needs of management or, more precisely, the parameters of management decisions should determine the outputs of a truly responsive MIS. Consider the process depicted in Figure VII-4. For convenience, the system life cycle is divided into development management and fleet management. In the logic of the theoretical construct, the outputs of the MIS support decisions and determine the processing and analysis required. This, in turn, drives the data collection effort. The informational needs of management are dynamic; certain decisions will obviate old requirements and dictate new ones. Most important, an MIS must satisfy needs at various echelons, not the least of which is the working level, while still retaining visibility from the top.

7.3.1 Systems Presently Available and Under Development

Currently, a number of management information systems fill some identified needs. Some principal examples are:

- WHEELS Fleet Model
- AMC-71 Ground Mobility Model
- RAC Pooling Model
- Structure and Composition System (SACS)
- Life-Cycle Cost Model
- DCSLOG P-20 Model
- RAC Study 012.113
- Standard Army Logistics System (SALS)
- USAMSAA Study, "Average Useful Life of Four Major Payload Vehicles."

An examination of these systems leads to the conclusion that, with the exception of SALS, they are primarily involved in conceptual planning, development, and manipulation of program and budget factors. Either they do not address or they assume the existence of costs and other factors of fleet operation and support. For example, the WHEELS Fleet Model assumes the existence of vehicle economic lifetimes and cost factors, which were actually developed on a one-time basis and only after 6 months of effort. Historically, whenever basic vehicle operation and support information has been required to support an important management decision, a special study has been convened. Thus, USAMSAA develops information on economic life, and various Research Analysis Corporation (RAC) studies have been made on overhaul and replacement. (These systems are discussed in depth in Annex I, Volume III.)

7.3.2 Management Information Improvements

(1) Management information systems are determined by the outputs required of them. The manager must define the parameters of vehicle decisionmaking and the correlative MIS outputs. The

majority of outputs would probably support several decisions. The number and variety of such outputs are limited only by the manager's ingenuity. The following are some of the more important outputs required of a vehicle MIS:

Accident analysis
Acquisition costs
Management costs
Overhaul costs
Provisioning costs
Transportation costs
Maintenance costs by level
Maintenance labor cost/mile
Frequency of unscheduled maintenance
Operating costs/mile
Spare part costs/mile
Age/distribution
Organizational distribution
Availability rates
Economic fleet mixes
Economic life
Forecasts
Learning curves
Mobility constraints
Mobility indices
Resale value
Scrap value
Test results
Trends analysis
Usage by type unit

(2) A brief examination of this sample list is sufficient to confirm the current nonavailability of much of this type of data to the decisionmaker. The experience of the WHEELS Study Group in attempting to acquire similar data reinforces this fact. Equally illustrative is the situation whereby USAMSAA, which is attempting a replacement life analysis, is faced with a lack of available information and is taking 3 or more years to develop similar data. It has become increasingly apparent that a quantum improvement in the satisfaction of management information needs is required. The starting point would be a workable system of data collection.

7.3.2.1 Data Collection

(1) Data collection entails a system of gathering all of the essential facts regarding a specific subject. Several previous Army studies have illustrated the need for a data information system for tactical wheeled vehicles. The WHEELS Study, like previous Army studies pertaining to the economics of overhaul and replacement, has been plagued by the limited data available on tactical wheeled vehicles.

(2) During the late 1950's, concern was expressed regarding management procedures used to control and analyze the adequacy of maintenance and supply. The Army's Equipment Record System (TAERS) resulted from this effort. This system required the reporting of essential data on selected items of equipment. All units were

required to report on the selected items, with data sent via hardcopy directly from the source to a data bank. This created an extensive workload on the data bank. In addition, the data were rarely used in any decisions concerning the management policies for tactical wheeled vehicles. The staggering keypunch operation, the lack of a visible use for data, and the workload at the unit level caused the system to fall into disfavor. In November 1969, the Army replaced TAERS with The Army Maintenance Management System (TAMMS). The continuous universal data collection system was eliminated. Some sample data collection was initiated under TAMMS. Today, TAMMS provides little immediate data to make a management decision. Data for such decisions can be provided only 12 to 18 months after the initiation of a specific, limited one-time plan. Under development is SALS, which eventually will coordinate and integrate logistic data collection.

(3) Several approaches may be considered for establishment of an effective data collection program:

- Reinstatement of a system such as TAERS (possibly streamlined) by which data are collected continuously on every vehicle
- Development of a sample data collection system that collects specific data elements on selected items of equipment on either a continuous or an as-needed basis
- Development of a sample data collection system that collects continuous data from all vehicles in certain selected units
- Various combinations of the above.

(4) The third alternative is particularly interesting. Under TAMMS and eventually under SALS, a distribution of units could be selected which would give adequate representation to factors of geography, usage, and vehicle type. All data would then be collected from these units on a continuing basis. Augmentation of these units with specially trained data collection personnel (a practice already employed in the other Services) could ameliorate the workload, if necessary. The advantages of such a continuous sample unit collection system are as follows:

- It would provide both current and historical data for immediate decisionmaking.

- It would provide data over a range of operational and geographic diversity without the burden of universal collection.
- It could be adapted to fit future MIS collection emphasis.
- It would require fewer controls and administrative personnel, and yet could be managed intensively.
- Data gaps would not result; data would be available from introduction of equipment to disposal.

7.3.2.2 Data Processing and Analysis

An examination of existing systems reveals that the most effective ones are those primarily in support of conceptual planning and development. The outputs of the AMC-71 Ground Mobility Model, for example, are primarily used prior to the actual procurement decision. The experience of the WHEELS Study Group has been that meaningful data on fleet performance are difficult to acquire, and there is little evidence that such data contribute to management decisions. For the most part, decisions are made without data to support them.

7.3.2.2.1 Economic Analysis

There is insufficient recognition of the fact that economic analysis and the resulting outputs form the basis of a comprehensive system of both fleet management and development management. At the heart of economic analysis is the determination of economic life. The economic life of a vehicle, along with the cost/use/age relationships that must be developed to determine economic life, are vital to decisions of programming, replacement, overhaul, repair, and almost every other management action. Without an economic life analysis, there may be vehicle control, but not vehicle management. In consideration of this, a management information system that can provide, on a responsive basis, the average economic life of vehicles in the fleet and the correlative cost/life relationships is an urgent need. Such a MIS will become the informational focal point for vehicle management.

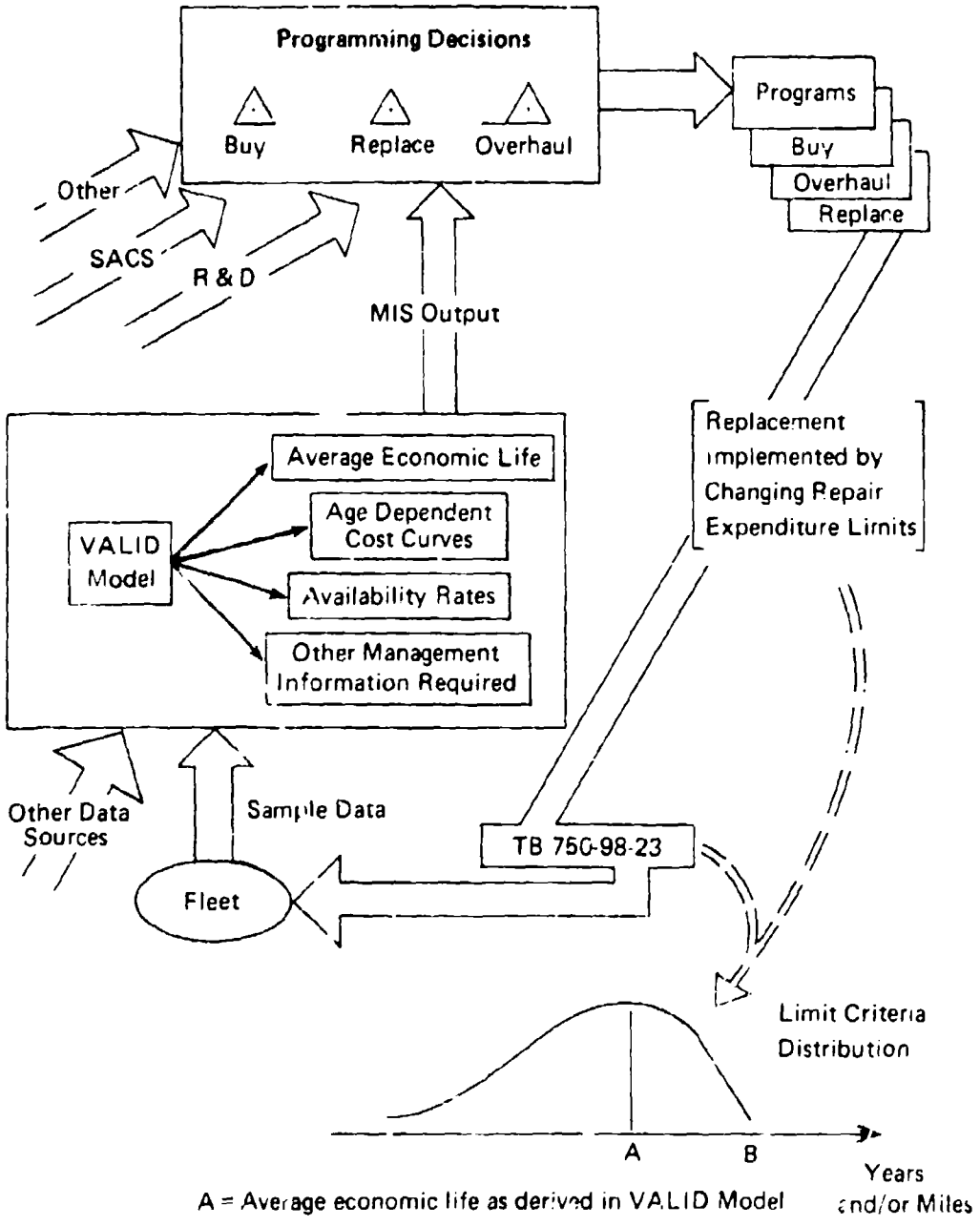


FIGURE VII-5. ECONOMIC ANALYSIS IN VEHICLE MANAGEMENT

7.3.2.2.2 The VALID Model (Proposal, Functions, Construct, and Benefits)

(1) A model can be developed to satisfy this identified need for inventory management information. The model would systematically, and at least annually, compute the average economic life of each vehicle type in the fleet. In addition, it would output in appropriate format such other information as specified by the manager. It could readily be integrated into a possible future all-system information program (e.g., SALS). For simplicity and ease of discussion, this proposed model is identified hereinafter as the Vehicle Average Life Information Developer, or the VALID Model.

(2) To illustrate the flow of the VALID-based information system, consider Figure VII-5, and the point in time immediately prior to the budget cycle. Data have been systematically collected during the preceding months and are available to the model. The model takes the input data, processes them, and automatically outputs the new average economic life by body type for the vehicle fleet. It is important to understand here that average economic life is not fixed. It depends on costs and other inputs that vary with time. However, the VALID Model would give the average economic life as it is derived for that particular point in time, and that value would be an input into the programming process.

(3) Once the program is implemented, the procedure to bring the actual fleet character into line with that desired by the program is found in the regular modification of TB 750-98-23, which establishes maximum expenditure limits for repair. The distribution of the repair expenditure limit criteria should have as its statistical mean the program life for the body type. Assuming that the program life equals the average economic life, individual vehicles would therefore be replaced in such a manner that the actual average age of the fleet would approach the most economically desirable. The closer the program life is to the average economic life, the more cost effective would be the fleet's character.

(4) The preceding is just one example of the use of the VALID Model. The same information (i.e., the cost/age/use relationships) can support a myriad of other management decisions on a continuing basis. Decisions involving questions of overhaul, adequacy of maintenance policy, comparative performance, and a host of other issues can be supported for the first time by adequate data.

(5) A number of algorithms dealing specifically with military vehicle replacement have already been developed. USAMSAA is in the process of constructing a model as part of its study of vehicle useful life, and perhaps the most logical and inexpensive course of action would be to adapt and expand the USAMSAA model to conform to the requirements of VALID. ACSFOR, in coordination with the WHEELS Study Group, should identify those outputs of an MIS needed to support various levels of vehicle management decisionmaking. Based on these requirements, the Director of Management Information Systems (DMIS) can require expansion and modification of an existing model to provide a continuing management tool that can be integrated as appropriate into the overall Army MIS program. It is envisioned that the VALID Model would be programmed to make an economic comparison and to select the average replacement period that would provide the least average life-cycle costs.

(6) Every conceivable cost that in some way accrues to the Army during the life cycle should be considered in the model, and discounting procedures should be used. Of paramount importance are the age-dependent costs. At present, these are not available for economic analyses, but they are absolutely vital to the process. One input—availability—is worthy of special note. This is the consideration that governs replacement in industry but is frequently ignored in military analyses owing to its inherent resistance to quantification. There are several approaches by which nonavailability and the cost thereof can be considered. Two approaches are suggested in Volume III, but a number of methods could probably provide an acceptable parameter. What is unacceptable, and what would invalidate an economic analysis, is the failure to consider nonavailability as a legitimate factor in the analysis.

(7) Benefits that would result from use of the VALID Model are:

- It would serve as a focal point whereby information needs could be defined, data collection plans implemented, managerial analyses accomplished, and decisions made. Active vehicle management would be achieved for the first time.

- Systematic use of economic analysis in the vehicle decisionmaking process would give the Army a practice similar to that of industry and would incorporate tried and proved concepts of vehicle management into the Army methodology.

- Factors that are not now quantified would be available to the decisionmaker, particularly when making intersystem comparisons. Better life-cycle costs would allow more valid tradeoffs with other weapons systems and within the wheeled vehicle field. Determination of the true cost impact of decision alternatives would be facilitated.

- It would offer firm evidence of a rational basis for vehicle programming actions and budget requests, providing a definite advantage in dealing with the Congress and DOD.

7.3.2.3 General Functional Systems Requirements Summary

As a point of departure for action by the ACSFOR, the WHEELS Study Group, and the DMIS, this section has been capsulated in a summarized General Functional Systems Requirement (GFSR). The appropriate sections in Annex I, Volume III, address specific chapters required in a GFSR. It is emphasized that an extensive, totally new management information system is neither desired nor necessary. The substance of many of the processes of economic analysis that could be performed by the VALID Model are already contained in existing models. If appropriate, the MIS ultimately can be integrated into an all-system MIS (e.g., SALS) to preclude duplication of effort.

7.3.3 Recommendation

The WHEELS Study Group (Phase III), in coordination with ACSFOR, DMIS, and other appropriate agencies, undertake development of a management information system (MIS) to support vehicle-related decisionmaking. The MIS should be developed within the framework of ongoing MIS through their modification and integration.

CHAPTER VIII

WHEELS PHASE II RECOMMENDATIONS

8.0 GENERAL

To facilitate reader understanding, WHEELS recommendations have been included with the discussion of each subject area in the preceding chapters. This chapter contains a compilation of those recommendations.

8.1 MAJOR POLICY RECOMMENDATIONS

(1) Proposed quantitative increases in wheeled vehicle requirements (BOI, TOE, MTOE, TDA, or force structure) will be subjected to an analysis that demonstrates the total resource impact on the Army in terms of dollars, units, personnel, and operating expenses.

(2) The tactical wheeled vehicle program o ›ctive will be oriented to three general levels of mobility:

(2.1) Tactical High Mobility - The highest level of mobility designating the requirements for extensive cross-country maneuverability characteristic of operations in the ground-gaining and fire support environment.

(2.2) Tactical Standard Mobility - The second highest level of mobility designating the requirement for occasional cross-country movement.

(2.3) Tactical Support Mobility - A level of mobility designating the requirement for infrequent off-road operations over selected terrain with the preponderance of movement on primary and secondary roads.

(3) Because many commercial vehicles are capable of adequately performing selected functions in Army units, they will be considered as candidates in any analysis of tactical vehicle requirements. Generally speaking, demonstrated marketability eliminates the need for Army testing.

(4) Change AR 10-5 by adding subparagraph (14) (h) to paragraph 2-31a, which enumerates the responsibilities of ACSFOR. The introduction to 2-31a(14) reads, [ACSFOR shall be responsible for the] "overall coordination of the following activities to include provisions of the single Army contact point for these activities:"

(h) Determination of requirements for wheeled vehicles, including analysis of the total wheeled fleet in terms of trade-off between mission, function, and type, while seeking the most cost-effective fleet that will meet all tactical and administrative needs.

8.2 MAJOR IMPACT RECOMMENDATIONS

(1) Have the ACSFOR, in conjunction with the CG, USAMC, and the CG, USACDC, conduct a critical analysis of the Heavy Equipment Transporter (HET) development program and report the results with recommendations to the WHEELS Steering Group. (The currently scheduled IPR for type classification should be deferred pending Steering Group assessment of the analysis.) The analysis should specifically, but not exclusively, address the:

- Validity of the current requirements document
- Availability and ability of commercial tractors and semitrailers to satisfy requirements to haul heavy engineer equipment loads and/or tank loads
- Impact of potential increased requirements due to the introduction of larger commercial construction equipment such as the T-11/T-12 size dozers
- Adequacy of proposed corrections to hardware deficiencies in the XM746 tractor as reported by the Test and Evaluation Command
- Results of an ongoing (USATACOM) comparative evaluation of the XM746 tractor, a "derated" XM 746 tractor, and commercial candidate tractors
- Results of an ongoing (USATACOM) cost analysis of the XM746 tractor.

(2) Terminate the 1 1/4-ton XM852 program and authorize 1 1/4-ton commercial vehicles for all 1 1/4-ton applications other than those requiring a high-mobility vehicle.

(3) The reduction of requirements inherent in the entire WHEELS Study must be reflected in programming and budgeting for the FY 74 Budget and the FY 75-79 POM.

8.3 OTHER RECOMMENDATIONS

Chapter II. Minimum Essential Quantitative Requirements

Section 2.1 Recommended Vehicle Adjustments

Publish a change to AR 310-34 (Equipment Authorization Policies and Criteria and Common Table of Allowances) initiated by ACSFOR that will incorporate the rules established by the approved REVA into Section III (Motor Vehicles), Chapter 4, of the AR. The change will implement the approved REVA and provide definitive guidance to the TOE/TDA proponent concerning authorizations for wheeled vehicles in TOE/TDA units. (The complete change is contained in Annex B, Volume II.)

Chapter III. Minimum Essential Qualitative Requirements

(1) Establish goals designed to achieve a minimum essential capability in each of the three mobility classes in the Army wheeled vehicle program to:

(1.1) Serve as a basis for structuring the qualitative content of the mid- and long-term tactical fleet.

(1.2) Develop mission and performance envelopes for various vehicle roles, missions, and tasks.

(1.3) Determine research and development, product improvement, or other changes to vehicle specifications to provide the basis for production contracts.

(1.4) Orient the doctrine and organizational development, Materiel Requirements document production, Basis of Issue Plans, and TOE changes to integrate such goals.

(2) Provide vehicle candidates to fill the tactical support role with a non-powered front axle, commercial splashproof water

protection, and commercial SAE standard electromagnetic interference suppression.

(3) Modify the entire fleet for 12-volt lighting, reduce approximately one-half of the current winch requirements, and reduce the issue of tarps and bows by placing these items on an "issue on demand only" basis for vehicles engaged in troop movements.

(4) Subject the AMC-71 Ground Mobility Model to continuing refinement efforts with the objective of using it as a tool in the vehicle management process.

Chapter IV. Commercial Vehicle Study

(1) Relating to the commercial 20-ton dump truck:

(1.1) Type classify the commercial dump truck as standard A for selected engineer units, both Active and Reserve.

(1.2) Prepare a separate P-20, compute logistic factors, and carry item as a separate line in the P-1.

(1.3) Procure the same make and model (or source specify maintenance significant components) for counterpart Reserve units.

(2) Relating to the 8-ton commercial truck tractor:

(2.1) Approve for expedited DA staffing the Materiel Need (Abbreviated), in Annex D, Volume II, for commercial truck tractors for selected applications as prepared by WHEELS. Consideration should be given to source specification of maintenance significant components and to the total system requirements to include container chassis, semitrailers, and necessary materials-handling equipment for container operations.

(2.2) Prepare a separate P-20, compute logistic factors, and carry item as a separate line in the P-1.

(3) Relating to the commercial 1 1/4-ton truck:

(3.1) Cancel further efforts to design and/or develop a military standard 1 1/4-ton truck (XM852). Establish a requirement for commercial 1 1/4-ton 4 x 4 and 4 x 2 trucks to fill the 3/4 - 1 1/4-ton tactical support and tactical standard requirements.

(3.2) Prepare a separate P-20, compute logistic factors (giving full recognition to high-volume production rates), and carry item as a separate line in the P-1.

(3.3) Eliminate all M37 and M715 vehicles as the commercial 1 1/4-ton truck enters inventory.

(4) Relating to the tractor and semitrailer used to haul engineer construction equipment:

Establish a requirement for a 35-ton commercial construction equipment low-bed semitrailer to provide an adequate means to transport heavy construction equipment. This item should be compatible with the military-design 10-ton truck tractor (or the product-improved 5-ton tractor) as well as the proposed heavy-duty commercial truck tractor planned to replace both the 5-ton and 10-ton tractors in selected applications.

(5) Relating to acquisition and support:

(5.1) Develop and promulgate a regulation and/or pamphlet that describes an abbreviated acquisition process to be used for general- and special-purpose commercial vehicles being procured for TOE units.

(5.2) Support new commercial vehicles logistically with the standard Army support system. Maximum use will be made of Direct Supply Support (DSS) procedures, with no stockage of repair parts above direct support levels.

(5.3) Continue to support administrative-use (TDA) commercial vehicles through the special supply system (MFR manuals, limited stockage, FSNs and MPNs).

(5.4) Consider COPARS on a case-by-case basis, concentrating on CONUS and small, compact overseas applications (e.g., USARSO).

(5.5) Compute Authorized Acquisition Objectives for commercial vehicles in tactical roles on the same basis as for tactical vehicles, but recognize the continuous high-volume commercial production in the computation of production offset. During Phase III, the WHEELS Study Group will further study the potential for constraining procurement of commercial vehicles to minimize stockage.

Chapter V. Vehicle Selection Processes

Section 5.2 Cost Computation Methodology

(1) Subject to HQ, DA staffing of the individual definitions, amend AR 310-25, "Dictionary of United States Army Terms," to include the definitions for life-cycle related terms adopted by WHEELS.

(2) Subject to joint staffing, amend DODI 7041.3, "Economic Analyses of Proposed Department of Defense Investments," to reflect the WHEELS definitions of economic life, physical life, and technological life.

Section 5.4 Fleet Structure

(1) Initiate necessary action by ACSFOR to adjust the quantitative aspects of the GAMA GOAT CBOIP to reflect TVRB and WHEELS quantitative reductions, and to incorporate the adjusted CBOIP into appropriate TOE.

(2) Initiate necessary actions by DCSLOG, in coordination with the ACSFOR and DCSOPS, to effect distribution of GAMA GOAT assets in accordance with the CBOIP and in the following general order of priority:

- Units in the Active Forces that habitually operate forward of the brigade rear
- Units in the Active Forces that habitually operate between the division and brigade rear
- Units in the Reserve Force.

Chapter VI. Fiscal Year 1974 Budget and Fiscal Years 1975-1979 Program Objective Memorandum

(1) Have DCSLOG and USAMC, in coordination with the WHEELS Study Group (Phase III), determine the cost effectiveness/savings that can be obtained through standardization within a payload by reducing models (i.e., using excesses as a means of reducing Standard B items).

(2) Have DCSLOG and USAMC, in coordination with the WHEELS Study Group (Phase III), determine the cost effectiveness/ savings of substituting, through a time-phased plan, the excess 2 1/2-ton truck for the 3/4 - 1 1/4-ton M37 and M715 as a means of eliminating one payload from the fleet.

(3) Relating to the "1/4-ton truck, ABT" (6.1.1):

(3.1) Retain the FY 73 procurement program to provide more preferred assets, to preclude termination charges, and to provide an improved fleet through FY 79.

(3.3) Fund the overhaul of components and accessories for worldwide requirements.

(3.4) Curtail the overhaul of end items (except for MASF customers) pending a determination of:

- Economics of overhaul
- Cost effectiveness of overhaul with respect to model standardization
- Utilization of excess assets.

(4) Relating to the 3/4 - 1 1/4-ton truck, ABT (1 1/4-ton, high mobility, not included) (6.1.2):

(4.1) Procure a commercial vehicle in FY 75 (12,000) and FY 76 (14,000) for this fleet.

(4.3) Curtail the overhaul of end items (except for MASF customers) pending a determination of:

- Economics of overhaul

- Cost effectiveness of overhaul with respect to model standardization
- Utilization of excess assets.

(5) Relating to the 2 1/2-ton truck, ABT (6.1.3):

(5.1) Retain the FY 73 procurement program to provide preferred assets for all specific body types and permit modernization prior to a 5-year break in production.

(5.3) Fund the overhaul of components and accessories for worldwide requirements.

(5.4) Curtail the overhaul of end items (except for MASF customers) pending a determination of:

- Economics of overhaul
- Cost effectiveness of overhaul with respect to model standardization
- Utilization of excess assets.

(6) Relating to the 5-ton truck, ABT (6.1.4):

(6.2) Fund the overhaul of components and accessories for worldwide requirements.

(6.3) Curtail the overhaul of end items (except for MASF customers) pending a determination of:

- Economics of overhaul

- Cost effectiveness of overhaul with respect to model standardization
- Utilization of excess assets.

Chapter VIII. Management

Section 7.1 Management Processes

Subsection 7.1.1 "Qualitative Management Processes"

(1) Apply all available management information of the WHEELS Fleet Model and AMC-71 Ground Mobility Model in writing requirements documents (ROCs) for tactical vehicles to produce mission profiles that adequately describe the intended mission(s) and area of operations and allow for tradeoffs in design as opposed to mandatory single-value characteristics.

(2) Review the high-mobility test scheduled for early FY 74 for proper vehicle mix in consonance with WHEELS Study reductions and monitor the results to confirm performance predictions of the AMC-71 Ground Mobility Model.

Subsection 7.1.2 "Qualitative Management Processes"

(1) Relating to "Basis of Issue Plans" (7.1.2.1):

(1.1) Intensify ACSFOR and USACDC efforts now underway to complete development of an automated BOIP system.

(1.2) Intensify ACSFOR actions necessary to ensure currency of Standard Requirements Codes (SRCs) used in BOIP.

(1.3) Initiate ACSFOR action to change DA Form 3362a, "BOIP Continuation Sheet," to provide for identification of grade, MOS, branch, additional skill identifier, and number of personnel required.

(2) Relating to "Table(s) of Organization and Equipment" (7.1.2.2):

(2.1) Have HQ, DA provide accurate cost data and force structure information to TOE proponents and require USACDC to furnish a cost analysis of each TOE developed, revised, or changed.

(2.2) Use the management indicators proposed in Annex G, Volume III, as appropriate, during force structure considerations.

Subsection 7.1.3 "Development, Test, and Evaluation"

(1) Relating to "Relationship of Testing and Management Decisions" (7.1.3.2):

Have ACSFOR revise AR 11-25, AR 71-6, and AR 71-8 and OCRD revise AR 70-10 to largely waive the need for Army tests of commercial vehicles when such vehicles are procured for TOE units and the item meets the commercial vehicle definition as described in Chapter IV of this volume.

(2) Relating to "Correlation Between Testing and Field Usage" (7.1.3.4):

(2.1) Have ACSFOR, with USACDC and USAMC assistance, establish definitive data on mission performance envelopes representative of actual field use for each type of vehicle, and revise USAMC test procedures accordingly.

(2.2) Have OCRD initiate a program to determine effects of age on vehicle characteristics.

(3) Relating to "Current Test Practices in Private Industry" (7.1.3.5):

Have USAMC write contracts for commercial vehicles in terminology concerning RAM-D characteristics that is consistent with that used by industry.

(4) Relating to "RAM-D Planning, Achievement, and Control" (7.1.3.6):

(4.1) Have DCSLOG and OCRD coordinate with the WHEELS Study Group (Phase III) to ensure that their requirements for feedback of data to support new developments, RAM-D assessments, product improvements, and commercial procurements are integrated into the wheeled vehicle management information system.

(4.2) Have the Deputy Chief of Staff for Personnel (DCSPER) and DCSLOG validate the desirability of establishing a data collection specialist program.

(4.3) Obtain FY 74 funding for OCRD to support a higher level of effort in development of methodology for designing mechanical equipment to prescribed reliability levels and for determining the effect of increased reliability levels on testing and life-cycle costs.

(4.4) Accelerate the ongoing OCRD RAM-D program improvement actions that affect wheeled vehicle programs to include:

- Methodology for relating RAM-D characteristics to operational capabilities and life-cycle costs and for establishing RAM-D requirements.
- Procurement practices aimed at providing durable/reliable wheeled vehicles.

Subsection 7.1.4 "Logistic Support Management Processes"

(1) Relating to "Assets and Inventory Management" (7.1.4.1):

(1.1) Have DCSLOG and USAMC develop procedures and implement an automated system in asset reporting that will systematically challenge gross reporting errors.

(1.2) Implement the receipt validation/in-transit reporting procedures envisioned in the Standard Army Intermediate Level Supply Subsystem (SAILS) in current logistical automatic data processing (ADP) systems.

(1.3) Include the subject of annual inventory of assets, as prescribed by AR 740-26, as an item of interest for The Inspector General.

(2) Relating to "Maintenance Management" (7.1.4.2):

(2.1) Have DCSLOG accelerate the actions under maintenance support positive and expedite additional study, considering factors such as acquisition cost, usage, design, operating cost, and density as a basis for revising maintenance policies for each payload tactical vehicle.

(2.2) Have DCSLOG revise AR 750-4 to specifically empower USAMC to develop the Army's worldwide depot maintenance program.

(2.3) Curtail programming of overhaul of tactical wheeled vehicles for the U.S. Army until the economics of the overhaul and cost effectiveness can be assessed with respect to model standardization and utilization of excess assets.

(2.4) Repair unserviceable, economically repairable tactical wheeled vehicles to direct support/general support standards as applicable using TB 750-98-23 as the maintenance expenditure limit.

(3) Relating to "Type Classification—Contingency and Training" (7.1.4.4):

(3.1) Run a correlation by USAMC of the age distribution/age equivalent study methodology and formula for use in developing replacement requirements with the procedures developed by MIMS and those utilized in computing annual replacement requirements during the AMP/budget cycles and submit a draft Army Regulation to DA for approval and publication.

(3.2) Conduct an in-depth supportability study by USAMC annually in conjunction with the Army Materiel Plan for each tactical wheeled vehicle model series to include C&T.

(3.3) Have USAMC develop disposal plans and check points to ensure that C&T assets are rapidly removed from the inventory.

(3.4) Have USAMC publish supporting pages in the Major Item Distribution Plan (MIDP) reflecting the phase-out planning for C&T assets.

(4) Relating to "Distribution and Transportation" (7.1.4.5):

(4.1) Have DCSLOG and USAMC develop and implement procedures to include in the MIDP all programmed overhaul scheduled for redistribution.

(4.2) Reduce the time required by USAMC to produce the MIDP from 90 days to a maximum of 45 days and publish the MIDP in phase with other budget and planning documents.

(5) Relating to "Motor Vehicle Warranties" (7.1.4.7):

(5.1) Continue Government acceptance of warranties that are the custom of the trade, but evaluate the costs of the warranties by requesting prices with and without a warranty.

(5.2) Request extended warranties beyond those that are customary. Evaluate the costs of these provisions by requesting prices with and without more extensive warranty provisions as exemplified in Appendix 4, Annex G, Volume III.

(5.3) Make concerted efforts by DA and USAMC to ensure that the benefits of warranties are obtained. Include: publication of an Army Regulation outlining command responsibilities, publicity focusing upon the benefits to the user, disciplinary actions, comparative statistics, cross-checks of parts requisitions, and maintenance of service records throughout the full warranty period.

(6) Relating to "Engineering Support to Production" (7.1.4.8):

(6.1) Conduct a manpower evaluation of the USATACOM capability to absorb, in-house, the ESP for vehicles and trailers not currently in production. Couple this evaluation with an economic analysis following the guidance in AR 37-13.

(6.2) Have USAMC evaluate the current Caterpillar Tractor Company ESP performance contract for the GOER and the AM General 2 1/2- and 5-ton ESP contracts to determine, at the end of the contract period(s), the advantages, disadvantages, cost effectiveness, and performance of a single contractor charged with the total ESP and production effort.

(7) Relating to "Disposal" (7.1.4.9):

Have USAMC expedite implementation of DCSLOG's proposed change to AR 755-1 which provides for automated use of predisposition instructions and reduced processing time for disposal actions.

(8) Relating to "Mobilization Planning" (7.1.4.10):

(8.1) USAMC consider the WHEELS AAOs in mobilization planning and reexamine the planning priorities accordingly.

(8.2) Revise DCSLOG policy requiring the inclusion of warm base mobilization production schedules in the AMP to require inclusion of the actual base condition.

(9) Relating to "Leasing" (7.1.4.12):

(9.1) DCSLOG, in coordination with Chief, Office of Reserve Components (CORC), and other Staff agencies, sponsor a 1-year test during FY 74 of leasing 5-ton commercial tractors for selected Reserve medium truck companies.

(9.2) Have USAMC lease commercial tractors for the Reserves under guidance from DCSLOG in coordination with CORC and other Staff agencies, if the test defined in (9.1) is successful.

(9.3) Proceed with leasing of other size vehicles for the Reserves in FY 76 with initial priority on 20-ton commercial dump trucks and commercial 1 1/4-ton trucks, provided the tractor leasing in (9.1) is successful and an analysis shows that leasing applies to other payloads.

(10) Relating to "Procurement Concepts" (7.1.4.13):

Support all multiyear program proposals by an analysis that compares the multiyear alternative to a single-year buy alternative for the entire multiyear quantity.

(11) Relating to "Vehicle Exhaust Emissions" (7.1.4.14):

Complete the cost-effective analysis of the proposed 1975/1976 Gaseous Emission Standards now underway by USAMC at the earliest possible date, with a target for submission of 15 January

1973. Based upon the results of the USAMC analysis, reassess the Army's current policy and direction of efforts in the exhaust emission campaign.

(12) Relating to "Sizes of Passenger-Carrying Vehicles" (7.1.4.15):

Modify AR 58-1 to incorporate the requirement to specify compact sedans in TDA wherever suitable.

Subsection 7.1.5 "Cost Management Processes"

(1) Have COA amend AR 37-18 as follows:

- Change cost element 4.014 (integrated logistic support) to include the "retail" portion of integrated logistic support for systems in the field.

- Change cost element 4.016 (depot maintenance) to include indirect maintenance costs (i.e., all costs incurred within or controlled by the depot maintenance activity, costs for all funded or unfunded parts consumed during depot maintenance of a system, and general and administrative expenses incurred outside the maintenance activities, but that indirectly benefit these activities).

(2) Have USAMC annually update tactical wheeled vehicle repair parts factors to reflect actual issue data and usage for future wheeled vehicle cost analyses.

(3) Provide assistance by COA in development and use of a management information system to support vehicle management (see paragraph 7.3) by coordinating the acquisition, processing, and assessment of cost inputs used in the system.

(4) Have COA, with the U.S. Army Field Operating Cost Agency as the executive agent, coordinate the development of a vehicle management cost file that will be responsive to all levels of vehicle management. This cost file should provide for basic quantitative and qualitative cost information for all wheeled vehicles.

(5) Have COA develop and maintain a current management cost summary handbook containing pertinent system information and the life cycle for wheeled vehicles. Continue examination by the WHEELS Study Group during the conduct of Phase III.

Section 7.2 Management Organization

(1) Continue examination by the WHEELS Study Group during the conduct of Phase III of the wheeled vehicle management organization, including HQ, DA, and major commands. Considering the integrated management mechanism and related programs, make final recommendations concerning wheeled vehicle management organization.

(2) Designate the Tactical and Commercial Wheeled Vehicle program as a subject for Systems Program Review.

(3) Continue the development of the AMC-71 Ground Mobility Model fully supported under continued USAMC sponsorship with the objective of its establishment as a DA management tool.

(4) Disseminate information on the current and potential capabilities of the AMC-71 Ground Mobility Model and its supporting research to all DA elements involved in vehicular ground mobility, combat developments, and RDTE elements.

(5) Designate the WHEELS Fleet Model as a DA planning tool and approve its use, maintenance, and continual updating during Phase III by the WHEELS Study Group in preparation for transfer to the OACSFOR.

(6) Develop and implement specific procedures during Phase III that will provide for appropriate USACDC and USAMC updates to the WHEELS Fleet Model data base in the respective areas of new SRC vehicular task descriptions and revised vehicular life-cycle parameters. Investigate means of improving the current interface between the WHEELS Fleet Model and the OACSFOR SACS.

(7) Direct no organizational changes with respect to wheeled vehicle management at the DA Staff level in consideration of the positive ongoing actions by the DA Staff, major commands, and WHEELS Phase III.

Section 7.3 Management Information Systems

The WHEELS Study Group (Phase III), in coordination with ACSFOR, DMIS, and other appropriate agencies, undertake development of a management information system (MIS) to support vehicle-related decisionmaking. The MIS should be developed within the framework of ongoing MIS through their modification and integration.